Education and Implementation

- Mentoring/Follow-up, Data Reporting and Retention Support
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Mentoring/Follow-up, Data Reporting and Retention Support

Education and Implementation Panel Report:
Mentoring/Follow-up, Data Reporting and Retention Support

Training Strategy and Follow-up in Germany: Structure, Efficiency and Outlook

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Introduction

Based on a long-term experience with the implementation of GLOBE in Germany two of the most challenging aspects in GLOBE are: 1. To get new trained GLOBE teachers started, and 2. To give experienced GLOBE teachers "new aspects" for their work. After 2 years as Country Coordinator in Germany I would like to summarize the work we have done so far and what we are up to based on a short evaluation.

Method

In February 2002 we started a major campaign to recruit new GLOBE schools. So far we have organized 7 Teacher Training Workshops (with 5 more to come), which involved approximately 140 teachers. In order to evaluate our efficiency we looked closer at the statistics in order to know how long it takes until new GLOBE schools make their first data entry. We were especially interested in the teachers' opinion regarding our training strategy. Coming back to the second point mentioned above, we are currently starting 3 new projects where "experienced" but also "new" GLOBE teachers are invited to participate.

Conclusion

Based on interviews during the workshops and telephone calls after the workshops there are a few issues that we have to consider for future teacher trainings in order to increase our efficiency. Major aspects are: 1. Money at German schools is pretty tight which is one of the major aspects why schools do not start within weeks because the lack of materials, 2. Computer work seems to be pretty tricky for new teachers which results in delayed data entry, and 3. The Teacher Guide is much too large.

Education and Implementation Panel Report:
Mentoring/Follow-up, Data Reporting and Retention Support

Investigating GLOBE Teacher 'Take-Up' or Reflective and Collaborative Practice After GLOBE Program Training Workshops: Case Study in Cameroon

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Abstract

This paper discusses one aspect of a three-year research project that investigates GLOBE teachers' 'take-up' from GLOBE Program training workshops initiated by GLOBE Program Cameroon in the year 2000. The researchers have described the overall pilot school program as "a practice-based case study". Data sources include teacher assessment at training workshops, GLOBE schools' communities' implementation strategies, quality and quantity of data collection, interviews with teachers and head teachers, questionnaires to GLOBE students and non GLOBE students.

One of the goals of GLOBE Program MINEDUC Cameroon is to extend GLOBE teachers' knowledge and skills in the GLOBE Program protocols and facilitate the integration of these protocols into the school curriculum. This paper considers what counts as 'evidence' of reflective and collaborative practice and what factors might enable or hinder the GLOBE teachers' capacities. It concludes with some suggestions for Country Coordinators in similar circumstances who have the task of building up the critical mass for the GLOBE Program in their countries.

Introduction

In 1998 Cameroon joined the Global Learning and Observations to Benefit the Environment (GLOBE) Program by signing a protocol agreement. The GLOBE Program targets learners and trainers. The training of the Country Coordinator and GLOBE teachers is an important first step in the implementation of the GLOBE Program in any GLOBE partner country. GLOBE Program Teachers' training workshops has the following aims:

- acquire knowledge and skill to implement GLOBE.
- broaden and deepen GLOBE teachers' subject knowledge
- broaden pedagogic subject knowledge, so as to extend GLOBE teachers reflective and collaborative capabilities.

Rationale and scope of study

When the GLOBE Program was introduced in Cameroon schools, the research team identified the management of GLOBE Program resources as a key factor in ensuring the success of the program.

The GLOBE Program resources include: GLOBE teachers, GLOBE Students, School administrators of GLOBE Schools, GLOBE Science Kits, Teachers' Guide, New Information and Communications Technology, finance, the school environment and time.
Assisting the GLOBE teachers during and after training gave birth to this research project which has the following aims:

(i) to investigate teachers 'take-up' from the GLOBE Program teachers training workshops.
(ii) their impact on their GLOBE students; and on the quality and quantity of data collection.
(iii) their capacity to integrate GLOBE Program protocols into the school curriculum.

The concept of GLOBE teacher take-up as used in this paper is defined as the reflective and collaborative capabilities of the teacher after GLOBE Program training. The reflective and collaborative capabilities are a function of:

a) the GLOBE teachers' attitude to science
b) The GLOBE teachers' science education background
c) The GLOBE teachers' school environment.

Research Design

The objectives of this research are formulated into a hypothesis. In this hypothesis, the dependent variable is the GLOBE teacher "take-up", or the teachers' reflective and collaborative capabilities, whereas the independent variable constitutes the GLOBE teachers' training workshop, using the GLOBE science kits and protocol. The hypothesis:

i) Null Hypothesis:
After a GLOBE Program teacher training workshop, there is no significant difference in the GLOBE teachers' "take-up" or reflective and collaborative capabilities, necessary for training the student in the use of the GLOBE Program protocols.
ii) Alternative Hypothesis:
After a GLOBE Program teacher training workshop, there is a significant difference in the GLOBE teachers' "take-up" necessary for training the student in the use of the GLOBE Program protocols.

This work assumes that all the teachers who have participated at GLOBE Program teacher training workshops, have a certain minimum education necessary for following up the GLOBE Program teacher training.

Research Question

The hypothesis in this work led the research team to put forward the following questions:

1. What do we mean when we use the term 'reflective and collaborative GLOBE teacher'?
2. What do we consider to be evidence of reflective and collaborative GLOBE capability?
3. What 'patterns' do we find in the reflective collaborative practices in GLOBE teachers?
4. What explanations can we offer for 'patterns' that we find?

Methodology

The data on which the paper draws were collected in seven rural and four urban GLOBE schools. Financial and time constraints meant that researchers were unable to visit all the GLOBE schools, therefore the schools surveyed were not randomly selected.
The data includes: transcribed interviews, teachers responses to questionnaires, observation of GLOBE data, collection and reporting of data by GLOBE students.

Questions on the teacher and student questionnaire were weighted as follows :
Weighting: 4 = Very Effective; 3 = Effective; 2 = Somewhat Effective; 1 = Definitely Not Effective; 0 = Not Trained.
The total score for each question (Table III) or group of questions (Table II) was found and the mean score calculated as follows:

Mean Score = (Sum of total score per group of questions for all the schools) x (Maximum weighting per question) = (Total maximum expected score)
Total Score per question = (Number of responses) x (corresponding weighting)

This was then used to decide the level of effectiveness and consequently the degree of significance.

Results, Data Analysis and Discussions

Attempts to define a reflective and collaborative GLOBE teacher.

A reflective and collaborative GLOBE teacher is defined by the researchers as one who understands the science concepts in the GLOBE Program, examines, frames and attempts to solve problems in the GLOBE Club, is attentive to the learners' backgrounds and attempts to integrate GLOBE activities in his class teaching; takes responsibility for his or her own professional development particularly in the use of GLOBE Program protocols. In addition to considering the possible difficulties for the GLOBE teachers in Cameroon, the researchers had to consider the GLOBE teachers' educational backgrounds i.e. of his or her being of the English or French system of Education. The Bilingual schools in Cameroon are essentially two schools in one, Cameroon Education Law (1998).

Challenges for reflective and collaborative GLOBE teacher in Cameroon

The very substance of reflective and collaborative capability of a GLOBE teacher involves taking seriously the GLOBE resources and the GLOBE School activities as well as validating and attributing significance to it. The large class sizes and very low salaries of teachers in Cameroon makes most teachers to put in just the barest minimum into their job, implying that most of them are not reflective and collaborative. A further factor to be considered is that the GLOBE teachers were asked to discuss their GLOBE Program activities with the researchers. It is possible that this factor may have influenced the results as it might have encouraged the teachers to display their apparent greater engagement to the GLOBE Program. When the project was conceptualised, the research team noted the difference between what GLOBE teachers "said" and what they "did", between their exposed and enacted practices.

In the interviews these teachers explained their enthusiasm in the GLOBE clubs with statements such as "the students enjoy doing GLOBE protocols". The data followed only in 50% of the test schools.
The following factors could have contributed to low data collection by the GLOBE students.

- GLOBE teacher's lack of comprehension of the protocols
- The GLOBE Science Kits too few for learners to be actively involved.
- Learners don't have sufficient time to complete their GLOBE tasks at local noon and break time
- There was no reporting back due to limited or no internet facility.
- Lack of sustained interest by GLOBE teachers and students in collecting and reporting data
- The GLOBE Program activity is done as part of the extra-curriculum, so only those students and teachers who are actually interested in it participate.
- Lack of interest due to no financial remuneration and poor salaries.

The GLOBE teachers spoke of how the GLOBE Program gave them ideas for using existing resources: social, cultural, and material to improve their classroom teaching.

Evidence from Quality and Quantity of Cameroon schools' data

The evidence from data collected is considered an important attribute to the evidence obtained from GLOBE teachers' spoken reflections.

Table I shows that the rate of teacher take-up is low at the beginning and improving gradually with time. This could be due to the fact that even though all of the schools surveyed have at least a computer provided by the GLOBE Program MINEDUC Cameroon, they lack access to Internet or email facility for reporting on time. Fax transmission has been tried with some schools but failed due to technical difficulties.

TABLE I : Surveyed GLOBE School Data Status as at June 17, 2002.

SCHOOL NAME AND LOCATION	**FIRST REPORT OF DATA**	**LAST REPORT OF DATA**	**TOTAL # Observations (Data Reported)**
Government Bilingual High School Mbengwi, NorthWest Province.	March 27, 2002	June 3, 2002	329
Government Bilingual High School Ndop, NorthWest Province. 🕮	October 26, 2001	April 29, 2002	1528
Cameroon Protestant College Bali, NorthWest Province.	March 29, 2002	May 30, 2002	372
Lycée Technique Industriel et Commercial Bafoussam, West Province. 🕮	March 21, 2001	May 6, 2002	2536
Lycée Classic et Moderne de Mvomeka'a, Province du Sud	May 3, 2002	June 11, 2002	289
Lycée Bilingue de Sangmelima, Province du Sud.	June 28, 2001	June 5, 2002	792
Government Bilingual High School Limbe, SouthWest Province.	March 31, 2000	May 21, 2002	698
Government Bilingual Practising High School Yaounde, Centre Province. 🕮	March 31, 2000	April 10, 2002	2627
Cameroon International School 🕮 Bastos-Yaounde, Centre Province.	February 15, 2002	May 21, 2002	762
Collège Teerenstra de Bertoua, Province de l'Est.	March 20, 2002	May 21, 2002	63
Government Bilingual Secondary School Bamenda, NorthWest Province.	March 19, 2002	April 29, 2002	521

Of the **11** schools surveyed :

2 Schools started data reporting in 2000	**3** more schools joined in data reporting in 2001	**6** more schools joined in data reporting in 2002

🕮 schools who have received congratulatory letters from the GLOBE Chief Scientist.

TABLE II : GLOBE Teacher Evaluation of GLOBE Teacher Training Workshops

Group of Questions	GBHS Mbengwi	GBHS Ndop	CPC Bali	LTIC Bafoussam		Sum Total Score	Expected Total Score	Mean Score
				A	B			
I.	34	22	32	38	34	160	220	2.91
II.	27	19	33	20	34	133	220	2.42
III.	25	16	35	18	28	122	200	2.44
IV.	12	3	10	8	15	48	120	1.60
V.	17	8	27	16	9	77	180	1.71
VI.	28	16	28	20	10	102	200	2.04

I. = General appreciation (participation at workshops, use of GPS, learning activities); II. = Atmosphere Investigation; III. = Hydrology investigation; IV. = Use of technology in GLOBE; V. = Land-cover investigation; VI. = Soil investigation (See Appendix).

The teachers' general impression took an average score of 2.91 which shows that 'General Participation including GPS and learning activities' in the GLOBE Program was 'Effective'. This implies that teacher take-up after workshop is significant. Teacher take-up viewed from the perspective of the GLOBE Atmosphere, Hydrology and Soil Protocols are Somewhat Effective, indicating that there is only a slight significant difference in teacher reflective and collaborative capabilities. There is therefore a direct relationship between these findings and the interview as well as data reporting status (Table I). Judged from Land-cover Protocol and the use of technology in GLOBE Program implementation, teacher take-up was definitely Not Effective, indicating that the Null Hypothesis is upheld.

TABLE III : Student Evaluation of GLOBE Teacher take-up

Questions	**WEIGHTING**				Total Score	Total # Respondents	Mean Score
	1	**2**	**3**	**4**			
A.	0	14	42	0	154	56	2.75
B.	12	22	13	9	131	56	2.34
C.	4	7	19	26	179	56	3.20
D.	23	21	3	9	110	56	1.96

A. = Number of students participating in GLOBE Program per school; B. = Time spent on GLOBE activities; C. = Data collection; D. = Use of technology in GLOBE (See Appendix).

From Table III, the degree of student participation at GLOBE activities in terms of number as well as data collection are effective, which is significantly different. Data collection appears to contradict the degree of effectiveness as seen in Table I. It is however noteworthy that the inability to report data regularly due to the problems already cited above accounts for this. Use of technology and time spent on GLOBE activities, is Somewhat Effective showing a slight significant difference in teacher reflective and collaborative capabilities.

Possible 'patterns' in the reflective and collaborative practices of GLOBE teachers

In this section of the paper we refer not only to evidence of the GLOBE teachers reflective and collaborative capability in running the School GLOBE club, but also to their reflection and collaboration in other areas of the curriculum.
The reflective and collaborative GLOBE teacher seemed to be strongly supported by the school administration and by some colleagues. (GLOBE teachers and colleagues analyse school Curriculum to identify GLOBE Program inputs- see annex). The school principal, the reflective and collaborative GLOBE teacher and the GLOBE students had working sessions in the principal's office to draw up a plan for data collection during the three months long vacation.

Summary of findings

Though evidence of teachers' take-up is very difficult to quantify, we found it possible to place each GLOBE teacher in one of three broad categories.

Attempted ranking of GLOBE teachers in relation to evidence of reflective and collaborative capabilities

Category A : showing some evidence of reflective and collaborative capabilities in relation to knowledge and skills in science concepts, club management, in pedagogy

- Lycée Technique Industriel et Commercial de Bafoussam, (LTIC)
- Government Bilingual High School Ndop, (GBHS)
- Cameroon International School Bastos, Yaounde (CIS)

Category B : showing some evidence of reflective and collaborative capabilities in relation to knowledge and skills in science concepts but disparity between espoused and enacted practices.

- Collège Teerenstra Bertoua, (COTEBE)
- Cameroon Protestant College Bali (CPC)
- Government Bilingual Practising High School Yaounde (GBPHS)
- Government Bilingual Secondary School Town Bamenda (GBSS)
- Lycée Classic et Moderne de Mvomeka'a (LCM)

Category C : Limited reflective and collaborative capabilities, limited knowledge and skills in science concepts, a great disparity between espoused and enacted practices.

- Government Bilingual High School Mbengwi (GBHS)
- Government Bilingual High School Limbe (GBHS)
- Government Bilingual High School Sangmelima (GBHS)

Possible explanations of differences in take-up.

Given that the goal of GLOBE Program Teachers Training Workshop is to enhance GLOBE Teachers 'take-up' reflective and collaborative capabilities, what explanations can we offer for the differences in the GLOBE Teachers?

GLOBE teacher's attitudes.

Read (2000), reviewing Pennington's reports of findings from research in teacher education held that, efforts to develop reflective capabilities are most effective;

(i) in those who already have reflective and collaborative attitudes or

(ii) who already show some predisposition towards reflectivity and collaboration in their attitudes of curiosity and interest in exploring knowledge.

After the December 1999 GLOBE Program Teacher Training Workshop, some teachers were more reflective and showed the most enthusiasm about acquiring the knowledge and skills of the GLOBE protocols.

Their reflective and collaborative capabilities were demonstrated by the questions they asked the researchers; in the knowledge and skill imparted to the GLOBE students and in the nature of GLOBE data collected.

The context in which the Cameroon GLOBE teachers work.

Education researchers have suggested that an appropriate and supportive school environment is a key factor in nurturing reflective and collaborative practice. In our study, some GLOBE Teachers received support particularly from the school head teachers while others lacked, and the presence of this support was a very important factor. The teachers who are more reflective and collaborative capabilities are also those GLOBE teachers who discussed the protocols with learners, other colleagues and the GLOBE protocol research team.

GLOBE Teachers' Science pedagogic knowledge.

We believe that GLOBE teachers' ability to reflect on GLOBE Program Protocols and to incorporate, adapt and integrate them into the curriculum is related to the depth and breath in their science subject knowledge. Researchers observed that GLOBE Teachers with limited Science knowledge and skill, affected negatively their ability to reflective and collaborative practice. The inability to reflect was particularly evident in the quality of GLOBE data reported.

Suggestions to GLOBE Program Researchers who wish to assist GLOBE teachers to become reflective and collaborative practitioners

The three GLOBE teachers we have placed in the category A for "showing evidence of reflection and collaboration are all GLOBE Teachers considered the best in the research sample. There is a relationship between successful GLOBE School and the GLOBE Teachers' reflective and collaborative practice. GLOBE Program researchers need to consider how to assist GLOBE Teachers to become more reflective and collaborative. A key finding from the research is that each of the GLOBE teachers in the study who was in the A category was also in the group classified as demonstrating good science knowledge and skills. GLOBE teachers in category B and C need more support in learning how to reflect and collaborate. For GLOBE Teachers of category B and C, researchers have to identify simple GLOBE Program protocols, and to add on gradually noting that it is easier to respond than to enact new practices.

GLOBE program protocols require a science base knowledge and keen observations and interpretations of data. The less one knows about what one observes, the less one can see, and the less one can see, the less one can learn and apply.

Small scale research projects of the GLOBE Schools
The research team proposed local small-scale research projects to the GLOBE teacher and provide guidance on how to collect data. GLOBE teachers carried out exchange visits in which reflective and collaborative practices in the GLOBE program was an important aspect of discussions and important for both teams. Category A GLOBE teachers mentoring category B or C GLOBE teacher.

A correlation study of this subject across GLOBE schools in Africa could be very useful in establishing general regional trends. Such trends could lead to a comparative study of the African region and the rest of the World.

Conclusion

From the above findings and discussions, it could be concluded as follows:

i) A conducive school environment, with administrative and infrastructure backup is a condition sine qua non for effective GLOBE teacher take-up necessary in the implementation of the Program in their schools.
ii) The GLOBE teachers' science pedagogic knowledge is an added tool in the acquisition of the reflective and collaborative capabilities. Those whose basic knowledge of science pedagogy is deficient, generally fall in category C as in the summary findings in (4) above.
iii) The GLOBE teachers' reflective and collaborative capabilities are enhanced by the letters of congratulations from chief scientist based on sustained interest in the quality and quantity of data reported.
iv) The GLOBE teachers' effective take-up, also depends to a great deal on the scientific culture of the teacher. This directly affects the teachers' responsiveness and attitude.
v) Student interest, attachment to GLOBE activities and performance in various science subjects in the GLOBE schools investigated, are also directly affected by the GLOBE teachers take-up.

Milton and Jane (1973:112), graphically sum up the importance of the GLOBE Program protocols and activity in the learning process by maintaining that: "the child is an active operator, whose actions are the prime generator of his psychological and mental development" This implies that activities provide opportunities for students to participate actively with others, in interactive programs, leading to the construction of knowledge.

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Education and Implementation Panel Report:
Mentoring/Follow-up, Data Reporting and Retention Support

SUBR GLOBE Partnership Multi-Dimensional Mentoring/Follow-Up
Southern University and A&M College GLOBE Partnership

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The Southern University and A&M College GLOBE Partnership is entering the 3rd phase of its development. In Phase I, the focus was on building a critical mass of university and K12 certified trainers across the southern region of Louisiana with multi-protocol competencies, while beginning to add to the GLOBE data archive. Phase II centered on experimenting with single-protocol school-based teacher certification; launching a Historically Black Colleges and Universities, Community College (HBCU/MI/CC) and Africa Collaboration GLOBE Initiative; and planning to integrate GLOBE in pre-service education programs in Louisiana colleges and universities. This panel presentation will describe the GLOBE HBCU/MI/CC-Africa Initiative, its major project elements, plans for implementing it in our Phase IV GLOBE Partnership program. Having trained and certified more than one hundred (100) K12 teachers, university faculty, staff, and students, we have put in place an evolving university/K12 support liaison system for local schoolteachers not yet reporting data. Our mentoring and follow up system has more than doubled the level of data reporting over the last year. Further, we are designing a system whereby campus partnership members are assigned schools and teachers to mentor in increasing further data collection and reporting activity. Finally, our secondary strategy for organizing a Louisiana affiliate has progressed to the point where we have four GLOBE Partnership institutions and three newly organizing university partnerships in the state to better coordinate school participation around the state.

History

Southern University and A&M College formally became a GLOBE Partnership in 1999. With four University faculty and staff members earning certified trainers certification upon completing the basic GLOBE training program at Hamline University in St. Paul, MN, October 13-18, 1999, the Partnership began. Southern University's GLOBE Partnership was organized as the K-12 component of a NASA funded PIPELINES Project covering the K-Graduate School domain and has continued it growth with campus training and support events for K-12 teachers, University faculty members, students, and staff members. Most recently, the Partnership hosted an international GLOBE certification-training event in Washington, DC where a number of Historically Black Colleges and Universities (HBCUs), Minority Institutions (MI), and Community Colleges (CCs) collaborated with GLOBE African Country Representatives and

Embassy Representatives. The Partnership has evolved through several phases as outlined below:

Phase I - September 1999 – August 2000
Consistent with plans presented by the Southern delegation at the end of the Hamline workshop, the Southern team promptly began integrating GLOBE into a University-Local School District partnership, with the support of a NASA funded project called ***Program to Increase the Pursuit of Education and Learning IN Engineering and Science (PIPELINES[1]***). In January 2000, Southern University Partnership leaders held a series of meetings with school officials, including the district East Baton Rouge Parish Schools Superintendent, Associate Superintendent for academic affairs, Supervisors of Science, Social Studies, and middle and high school programs. Enthusiastic support of the GLOBE program was expressed to the extent that the Superintendent requested that three (3) schools be added to the original eleven (11) targeted for GLOBE implementation. These three additional schools had been designated as GLOBE schools by a federal court order guiding the desegregation of the school system.

Phase II – September 2000 – August 2001
The Southern University and A&M College GLOBE Partnership is entering its 2nd phase GLOBE Partnership activity. In Phase I, the focus was on building a critical mass of university and K-12 based certified trainers across the southern region of Louisiana with multi-protocol competencies, while beginning to add to the GLOBE data archive. Phase II has three major elements, (1) cadres of certified Partnership trainers will conduct single-protocol school-based teacher certification across the region; (2) An HBCU/MI/CC GLOBE Initiative will be furthered to expand the number of GLOBE Partnerships on minority campuses around the country and internationally; and (3) work to integrate GLOBE in pre-service education programs in Louisiana colleges and universities. This panel presentation will overview strategies and approaches pursued by the NASA funded PIPELINES-GLOBE Project in conjunction with the Southern University GLOBE Partnership, the East Baton Rouge Parish School System, the Lafayette Parish School System, other urban school systems, and the HBCU/MI/CC community. Finally, secondary strategies for forming a Louisiana affiliate of three current and two newly organizing university partnerships to better coordinate school participation around the state, and to pursue a statewide coordination infrastructure will unfold in 2002.

Phase III – September 2001 – August 2002
The Southern University and A&M College GLOBE Partnership is entering its 3rd phase program. In Phase I, the focus was on building a critical mass of university and K-12 certified trainers across the southern region of Louisiana with multi-protocol competencies, while beginning to add to the GLOBE data archive. Phase II centered on experimenting with single-protocol school-based teacher certification; launching a Historically Black Colleges and Universities, Community College (HBCU/MI/CC) and Africa Collaboration GLOBE Initiative; and planning to integrate GLOBE in pre-service education programs in Louisiana colleges and universities. This panel presentation will describe the GLOBE HBCU/MI/CC-Africa Initiative, its major project elements, plans for implementing it in our Phase III and IV GLOBE Partnership program. Having trained and certified more than one hundred (100) K-12 teachers, university

[1] www.phys.subr.edu/pipelines

faculty, staff, and students, the Partnership have put in place an evolving university/K-12 support liaison system for local school teachers not yet reporting data. The mentoring and follow up system has more than doubled the level of data reporting over the last year. Further, the Partnership is being reorganized whereby campus partnership members are assigned schools and teachers to mentor in increasing further data collection and reporting activity. Finally, our secondary strategy for organizing a Louisiana affiliate has progressed to the point where we have four GLOBE Partnership institutions and three newly organizing university partnerships in the state to better coordinate school participation around the state. A special GLOBE train-the-trainer (TTT) workshop convened at Howard University, March 17th with the objective of expanding GLOBE training capacity on the campuses of HBCUs, MIs, and CCs. Additionally, the workshop was designed to establish research and instructional collaboration between and among U.S. universities (HBCUs and CCs) and African countries. Representatives from thirteen HBCUs, two community colleges, and six African nations were represented among trainees for the 5-day event, where environmental sampling was conducted on Howard and Gallaudet University campuses and in Rock Creek Park. A total of thirty-eight trainees increased their knowledge of GLOBE protocols through classroom instruction, field experiences, cultural events, and computer lab sessions.

Mission

The Southern University GLOBE Partnership exists to increase minority participation in science, technology, engineering, and mathematics (STEM) fields through expanding global involvement in the Global Learning and Observations to Benefit the Environment (GLOBE) Program. It has been demonstrated that GLOBE is highly correlated with student development as measured by enhanced environmental awareness, increased scientific understanding of the Earth and improved student achievement in math and science. GLOBE exposed students elect STEM majors more often than their non-GLOBE counterparts. It is therefore the mission of the Partnership to recruit K12 teachers, train them, and support their implementation of the hands-on, measurement-oriented energy and environmental science curricula content consistent with state science, math, and social studies standards and benchmarks. Expanding beyond the traditional Southern University geographic coverage, efforts are directed at establishing and expanding partnerships to under participating institutions (HBCUs, MIs, and CCs), underserved regions (rural and urban centers), and Africa, an under participating continent.

GLOBE – Africa Initiative

During the 6th Annual GLOBE Conference, an international planning team convened in Blaine, Washington to begin planning an International GLOBE Training Workshop. Focused on West Africa, the first training workshop would be hosted by the University of Mali in late 2002 time frame. Due to fiscal constraints, the first training workshop was held in Washington, DC and hosted by Howard University and Southern University and A&M College. Plans from the Blaine meeting were widely disseminated to prospective participants in the U.S. and Africa. The planning team agreed to continue their work electronically (e-mail and videoconference) by recruiting participants, devising a workshop agenda, and working out logistical issues in concert with the GLOBE staff. A Concept Paper was developed to guide this effort (See Appendix #1).

A preproposal was developed and submitted to UNCF SP under their US Agency for International Development (USAID) administered International Development Partnership (IDP) program in fall 2001. Though our first effort, submitted under the aegis of the Science and Engineering Alliance (SEA), was unsuccessful, our expanded network has continued to prepare a proposal for submission in fall 2002. In preparation for the resubmission and for expanding potential funding sources, the Southern University GLOBE Partnership hosted an ***International Project Development Consultancy*** on June 27, 2002 on the Baton Rouge campus and videoconference sites in New Orleans, LA; Grambling, LA; and Salinas, CA. Fifty-five university faculty, administrators, and businesspersons from seven institutions covering three U.S. states and Nigeria participated in the all-day session. Dr. Jacqueline Howard-Matthews, UNCF SP Partnership Coordinator provided valuable information on project development and funding options to participants. Follow up actions will be clarified in a proceedings that will be hosted on the Southern University GLOBE web site at www.phys.subr.edu/phys along with a summary of the Howard TTT Workshop.

Additional contacts have been made with USAID Office of Sustainable Development Bureau for Africa.

Partnership Scope

- The GLOBE Program
- Science and Engineering Alliance (SEA)
- Southern University
- Howard University
- United Negro College Fund – Special Programs, Inc. (UNCF SP)
- East Baton Rouge Parish School District
- Lafayette Parish School System
- Louisiana Environmental Education Commission
- NASA MU-SPIN
- Adopt-A-Watershed, Inc.

Historically Black Colleges and Universities (HBCUs)

- Dillard University
- Elizabeth City State University
- Florida A&M University
- Grambling State University
- Jackson State University
- Lincoln University
- Livingstone College
- Mississippi Valley State University
- Southern University Baton Rouge
- Southern University New Orleans
- Southern University Shreveport
- Tennessee State University
- Texas Southern University

- Tulane University
- Xavier University

African GLOBE Partners

- Benin
- Cape Verde
- Ghana
- Guinea
- Madagascar
- Mali
- Senegal

Community Colleges

- Baton Rouge Community College
- Delgado Community College
- Hartnell Community College
- Nunez Community College
- Southern University-Shreveport Community College

Sponsor/Supporters

- Schaffer & Associates
- Gee Cee Group, Inc.

Impacts

The Partnership has increased the ranks of certified GLOBE teachers and trainers by one hundred and forty two (142) over the less than three years life of the project. Thus twenty (20) schools in four (4) school districts have been impacted with enhanced learning opportunities.

The number of students impacted is on the order of three thousand, based on one hundred and twenty eight (128) teachers and a 25:1 student to teacher ratio in most schools served by the Partnership.

Eighteen (18) U.S. institutions (fourteen (14) HBCUs and four (4) Community Colleges) have been introduced to GLOBE and many have begun to connect with local K12 schools and teachers.

In Africa, eight (8) countries have been linked to U.S. institution-partners, including HBCUs, Community Colleges, the Science and Engineering Alliance, NASA MU-SPIN, the International GLOBE Program, UNCF SP, the White House Initiative on HBCUs, NAFEO, the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE).

Path Forward

Carrying out the Partnership's 3rd and 4th phase of development shapes the future of the Initiative. We are currently developing an International Collaboration Project, with the help of UNCF Special Programs, USAID/USDA, and others. We are expanding our U.S. institutional partners, African Country participants, funding and sponsor partners to support projects arising out of partner collaborations.

On the home front, Southern University is leading a statewide GLOBE affiliate development, where encouragement has been secured from the Louisiana Governor's Office, the Louisiana State Department of Education, and the Louisiana Congressional Delegation. Involving youth in public, charter, home, and private schools, clubs, church support groups, and detention centers are targets for the future.

Appendices

Appendix #1 - HBCU-MI-CC Africa International Initiative
Appendix #2 - Collaborators & Collaboration Summaries
Appendix #3 – GLOBE Africa Train-The-Trainer Workshop Report

Appendix #1

The Global Learning and Observations to Benefit the Environment and Southern University and A & M College, Baton Rouge

HBCU-MSI-CC Africa International Initiative

(http://www.phys.subr.edu/pipelines/, http://www.globe.gov)
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July 24, 2001

An international planning team convened in Blaine, Washington during the 6th Annual GLOBE Conference to begin planning an International GLOBE Training Workshop. Focused on West Africa, the Workshop would be hosted by the University of Mali in late 2002 time frame. Plans from the Blaine meeting will be widely disseminated to prospective participants in the U.S. and Africa. The planning team agreed to continue their work electronically (e-mail and videoconference) by recruiting participants, devising a workshop agenda, and working out logistical issues in concert with the GLOBE staff. Herein is the outcome of the planning meeting.

BACKGROUND: The International GLOBE Project and Southern University and A&M College Baton Rouge (SUBR) conceptualized an initiative to increase GLOBE participation of historically black colleges and universities (HBCUs), minority-serving institutions (MSIs), and community colleges (CCs) in the U.S. This HBCU-MSI-CC Africa International Initiative is in the formative stages of developing a continental bridge among U.S. HBCUs, MSIs, and CCs and universities and schools on the African continent.
The initiative was formally established March 2001 when a group of HBCU representatives, GLOBE Headquarters staff, NASA, NSF, and supporters gathered during the National Association for the Equal Opportunity in Higher Education Annual Conference to brainstorm an approach to further diversify GLOBE participants.

GOALS AND OBJECTIVES: Currently, only a handful of the 117 HBCUs and several African countries are participating in the worldwide GLOBE effort of enhancing environmental awareness, increasing scientific understanding of the Earth, and supporting improved student achievement in math and science. The paramount goal of this initiative is to build bridges across the Atlantic Ocean to link the United States and Africa in developing and deploying strategies to increase the collaboration and cooperation among HBCUs, MSIs, CC, and African universities in GLOBE with a long term goal of addressing the under representation of minorities in science, mathematics, engineering and technology global enterprise. Three specific objectives have been identified:
To promote more collaboration and cooperation among historically black colleges and universities for the explicit purpose of enhancing their positive impact on their surrounding schools—with emphasis on science, mathematics, engineering, and technology education (SMET) using GLOBE;
To promote more collaboration and cooperation between HBCUs and African Universities, for the clear purpose of enhancing the support infrastructure of GLOBE Partnerships in Africa;
To begin dialogues, exchanges, and other program developments for the aim of accomplishing the threefold mission of instruction, research, and service of the African universities and of the

HBCUs—with initial emphasis on joint projects in Earth and environmental sciences, global climate change research, and attendant issues.
To promote the participation of primary and secondary/high school in SMET activities that would bring about enhancement in the pedagogies using GLOBE as a focus for enrichment of the quality of life.
To promote a more effective networking system for collaboration, cooperation, exchanges and leveraging of resources to uplift the level of representation of minorities in the global SMET efforts at all levels of education systems and enhance respective national development goals.
To sensitize, particularly African Universities and or Research Institutions to be aware of the reliable global database utility of GLOBE that could be easily tapped to facilitate research on environment-related subjects.

STRATEGIES AND ACTIVITIES: Three major initiative events were discussed and the team agreed to continue implementation of the initiative over the next two years.

A GLOBE Videoconference and Webcast hosted by Southern University, Howard University, Florida A&M University, and Xavier University of New Orleans invited more than 40 HBCU/MI/CCs to explore GLOBE Partnership participation. HBCU and GLOBE leaders provided overviews of GLOBE-relevant activities at headquarters and on participating campuses. The event was held on June 13, 2001 and the Webcast can be viewed at:
http://www.famu.edu/famcast/video/globe/
Howard University in Washington, DC is prepared to host a national HBCU GLOBE Training workshop in the spring 2002 with the objective of expanding minority participation and preparing a cadre of HBCU/MI/CC faculty to become GLOBE certified and implement campus-based GLOBE partnerships. Representatives from Africa would also participate. This has already happened. Should be written past tense?
SUBR and GLOBE are proposing an international GLOBE training conference, to be held in the fall of 2002, Bamako, Mali (or possibly in Timbuktu). New and existing GLOBE partners will be invited to become GLOBE certified or refresh their skills during this training. New partnerships will formalize and K-12 students will join over 100,000 students worldwide in the protection and maintenance of our global environment. Recruitment from all African institutions and all HBCU/MSI/CC institutions in the U.S. This event is being planned for the fall 2002.

Appendix #2

COLLABORATORS & COLLABORATION SUMMARIES

HBCU/CC-Africa Projects

GLOBE TRAIN THE TRAINER WORKSHOP

Building Capacity: Linking Across the Atlantic

Hosted by

Howard University & Southern University

March 21, 2002

Group I-members include: Garry Ford, Ervin Howard, Barbara Johnson, Delores Ray, Wilson, Aileen M. Seshum, Warren Edwards, and Adams Moussa Traore

Presenter Delores Johnson shared the weeklong experiences of the group. With a variety of cultural and language differences Group 1's collaborative efforts include:

- Country to Country interaction
- University collaboration with K-12 teachers
- Pre-service training for undergraduates
- Faculty exchange between countries
- Issues of interests shared:
- Fires, Ecology of Rivers, Land Lost (Land Cover), Weather, Sea Surface Temperature
- How will the collaboration be done?
- Video Conferencing, Web chat, List serve, Chat room sessions, E-mail/Web Page posting, Travel

Group II-members included: Mamadou Nadiaye, Joseph Orban, Curtis McDonald, LaTasha LaMotte, Michele Akpo, Sherry Gibson, and Anthony Aramburo

Presenter Anthony Aramburo shared the group's collaborative interest in:

- Universities - Research/Grants
- Teacher/Teacher - Collaboration among peers
- Student/Student - In schools

Issues of Interest:

- Exchange and Collaboration between group members, Interpretation and use of data already collected in countries and by universities. Aerosol (dust from wind storms) in African Countries and the patterns of movement as contrasted with sugar cane burning in Louisiana for example. Also erosion and water resources could be considered.
- How will the collaboration be done?
- E-mail, Internet, Newsletter, Video

Group III-members included: Margaret Besong, Karen Martin, Alidjennatou Aliou Emmanuel, Gwendolyn Ray-Brooks, Michael Davis, and Clarence Bostic

Presenter Karen Martin shared the collaborative interests of the group:

- Collaboration of students and teachers on all levels;
- Elementary, Middle, High School, Colleges, and Universities
- Middle School will be the primary focus
- Issues of Interest:
- Interdisciplinary research
- Language and Mission Geography/Remote Sensing
- Lead Contamination
- Substance abuse
- How will collaboration be done?
- Internet - GLOBE Web site-link/Projects, Compressed Video, Face-Face, E-mail/GLOBE Mail/Chat room

Group IV-members included: Lionel Lyles, Fanta Berthe, Danny Hubbard, Teng Zhu, Albert Rafalinanana, MB Goli, Mehri Fadavi

Presenter Lionel Lyles shared the group's collaborative interest in:

- Data sharing (resource expertise)
- Collectively analyzing data to transmit to students
- Faculty to faculty
- Faculty to student
- Student to student
- Technology sharing—GIS/GPS

Issues of Interest:

- Local environmental issues that translate globally
- Land Cover, Water, Atmosphere
- Collaboration will be achieved through:
- Internet, Video Conferencing, Training exchange, Grant proposal to fund efforts

Group V - members include: Celeste Williams, Beulah Lavergne-Brown, Charlene Frontiere Regina Patterson, Ed Valeau, Carl Gant, and Ousmane Koita, Ana Cristina Ferro Marques

Presenters' Ousmane Koita and Charlene Frontiere discussed the group's collaborative plans.

- Implementation support for teachers
- Teacher/University support for incorporation into school curriculum

Issues of Interest:

- Mali has a unique protocol for measuring UBV. Teachers are needed in the field to collect data for universities, which will compare data with NASA probe. There appears to be a link between UVB and levels of Malaria.
- Replicate study at a college in the United States
- How will collaboration be done?
- Internet, Electronic Journals, Video, GLOBE Mail, Travel – Exchange of Faculty and/or Student, Cultural change of data/contact to and from Mali

Appendix #3
GLOBE TRAIN THE TRAINER WORKSHOP
Building Capacity: Linking Across the Atlantic
Hosted by:
Howard University & Southern University
March 17-22, 2001

A special GLOBE train-the-trainer (TTT) workshop convened at Howard University, March 17th with the objective of expanding GLOBE training capacity on the campuses of Historically Black Colleges and Universities (HBCUs) and community colleges (CCs). Additionally, the workshop was designed to establish research and instructional collaboration between and among U.S. universities (HBCUs and CCs) and African countries. Representatives from thirteen HBCUs, two community colleges, and six African nations were represented among trainees for the 5-day event, where environmental sampling was conducted on Howard and Gallaudet University campuses and in Rock Creek Park. A total of thirty-eight trainees increased their knowledge of GLOBE protocols through classroom instruction, field experiences, cultural events, and computer lab sessions. (Appendix with list of participants).

The workshop began on Sunday, March 17, 2002 with a reception and orientation for all registered participants at the Washington Plaza Hotel and hosted by Howard University. Dr. Ralph Coppola (GLOBE), Dr. Diola Bagayoko (SUBR), Dr. Robert Ford (SUBR) and Dr. Jim Johnson (Howard University) made welcoming remarks to attendees and explained the course of training for the week.

On Monday, participants were introduced to GLOBE educational materials to be used during the training sessions. A discussion of the collaboration objectives ensued, after which group assignments were made to assure diversity of group members and geographical regions. Before lunch, participants were introduced to instruments used in the Atmosphere protocol. Other introductory activities included, the thermometer activity, aerosols and a learning activity called "Just Passing Through". After lunch some group assembled outside for the introduction to the Atmosphere Protocol while other groups traveled to Rock Creek Park to begin the Hydrology protocol. At the end of each day, the groups were reassembled to reflect on the day's activities. Dr. Coppola, Dr. Ford and Hudson Roditi, GLOBE trainer and translator conducted the closing session.
The Tuesday and Wednesday sessions were focused on the continuation of instruction in the GLOBE protocols of Atmosphere, Land Cover, Soil and Hydrology. On Thursday, groups returned to Rock Creek Park and Gallaudet University for additional training in soil and land cover protocols. At the end of the day, a banquet was held providing the five participating groups an opportunity to share their training experiences and their plans for collaboration and implementation at their respective institutions or countries. All of the groups were interested in continued collaboration with international participants via the Internet, webcasting, GLOBE chat rooms, videoconferencing and international visits. It should be noted that two of the groups have begun working on grants through corporate/private entities to fund the exchange visits and research opportunities.

At the invitation of the SUBR GLOBE Partnership Coordinator, Dr. Robert Ford and the International GLOBE Office, representatives from three (3) embassies were on hand to support their country representatives. Each embassy representative spoke of the exciting possibilities GLOBE offers their respective countries. (See the attached Banquet Summary (Exhibit I), Collaboration Summaries (Exhibit II), and the list of Banquet Participants and Embassy Representatives (Exhibit III). The closing ceremony was held Friday, with all participants receiving their GLOBE certification awards and information for future collaboration with the Southern University PIPELINES Project. NASA representative James Harrington was on hand to share information regarding NASA funding opportunities. (See photo gallery of training pictures, agenda of training activities, participants list)

Visiting Professor Activity—University of Mali

At the conclusion of the GLOBE HBCU/Africa training, Dr. Bagayoko invited one of the professors from the University of Mali to visit Southern University in Baton Rouge. Madame Fanta Berthe' is a professor of chemistry and physics at the University of Mali, West Africa. She participated in the HBCU GLOBE International Workshop in Washington, D.C. before her arrival at Southern University—Baton Rouge, March 25- April 3, 2002. She conducted three videotaped sessions on the curriculum in mathematics, environmental science, and chemistry and physics. She met with faculty and students on curriculum design in Mali and the differences in curriculum in the United States. Additionally, she participated in the NOBCChE Conference in New Orleans, Louisiana, March 26, 2002, and a guest lecturer for the Timbuktu Academy, Tuesday, April 2, 2002.

NOTE: A partnership consortium of organizations including NASA's MU-SPIN program, NASA's Stennis Space Center, Southern University and A&M College, Howard University, and GLOBE implemented the workshop. Additional funding was provided under the PIPELINES Project, a partnership between Southern University and A&M College and Iowa State University. PIPELINES is funded by the Earth Science Enterprise of the National Aeronautics and Space Administration (NASA)

BANQUET SUMMARY
GLOBE TRAIN THE TRAINER WORKSHOP
Building Capacity: Linking Across the Atlantic
Hosted by:
Howard University & Southern University
March 22, 2001

The GLOBE/HBCU/Africa-MI-CC Train-the-Trainer Workshop held it culminating activity on Thursday night, March21, 2002 at 6:30 p.m. in the Washington Plaza Hotel. All of the registered participants and invited guests (57) were on hand to hear the collaborative reports of the five groups. Dr. Robert L Ford made opening remarks, defining the GLOBE Program for some of the audience members and explaining the significant work conducted by the participants during the training week. Ms. Marilyn Lanier-Nolley, Special Assistant to Dean James Johnson, greeted the group on behalf of Howard University, the workshop site host. Dr. Diola Bagayoko gave welcoming remarks from Southern University and shared his excitement for the work conducted during the week and the future collaboration with HBCU's and international participants. Before dinner was served, representatives made remarks from several embassies

and international diplomatic corps that attended to see and hear about collaborative efforts proposed by their countrymen.

Embassy representatives included:
Mr. Mahame Binia Toure, Counselor - Embassy of the Republic of Mali
Mr. Djimessa M. Auigah, Country Desk Assistant – Peace Corps for Malawi, Mozambique, South Africa, Zimbabwe
Hon. Jose Brito, Ambassador - Embassy of the Republic of Cape Verde
Dr. Charles Mintyene, Cultural Attaché - The Embassy of the Republic of Cameroon

Each of the embassy representatives declared support for the GLOBE program and described how the program could be useful in their respective countries. Ambassador Brito explained that Cape Verde is a country where 90% of all food, materials and supplies are imported. GLOBE may be useful in helping find ways for Cape Verde to support and sustain its people independently. The representative of Mali explained the correlation GLOBE research would have on health related issues in the country of Mali, particularly malaria. The representatives from Cameroon and Madagascar, which currently have the GLOBE Program in their countries, are looking for ways to expand its reach.

Other invited guests recognized by Dr. Ford, banquet facilitator, included, Dr. Robert Shepard, Science and Engineering Alliance, Mr. James Harrington, NASA Goddard Space Flight Center, Ms. Pamela Ansley- Clarkson Systems & Associates, Ms. Katrina Emery-NASA Dryden SFC, Ms. Pamela Heard- NASA Stennis SFC, and Ms. Doris Jones, NASA Langley Research Center, Hampton, VA. All of the invited guests reiterate the obvious relevancy of the GLOBE Program and their desire to support the efforts of the participants.

After dinner, Dr. Bagayoko reopened the evening with a presentation based on GLOBE data collected by schools following scientifically designed, developed, and field-tested protocols. These protocols address (a) requisite equipment specifications, (b) instrument calibration, (c) how, when, and where to measure, and (d) safety precautions, if applicable. These protocols insure data validity, accuracy, and reliability. Hence, GLOBE data are scientific data. By using these data, we are adopting the experimental set-up and measurement procedures described in the GLOBE Teacher Manual that is available in its entirety at the GLOBE web site.

The final presentations included fifteen minutes summary of their collaboration plan by each of the five workshop groups. The results of these collaborations are given in Appendix 2.

Education and Implementation Panel Report:
Mentoring/Follow-Up, Data Reporting and Retention Support

Iowa Academy of Science Partnership

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Educator Support and Iowa Academy of Science Partnership Goals

GLOBE's own evaluations have suggested that teachers are more likely to implement the program and report data if there is local support available (GLOBE 4th Year Evaluation, 1999). In response to this research, the Iowa Academy of Science (IAS) Partnership included teacher support as one of it's three primary goals: to provide training for Iowa Educators in GLOBE, to support educators once they are trained and to continually evaluate the program. The IAS Education Director provides many forms of support to GLOBE Trained Teachers.

Teacher Recruitment Support

The first level of support need by a teacher is support in attending the original workshop. IAS does this by making the workshops as easy as possible for teachers to attend. All Iowa workshops are free of charge to the teacher. Workshop sessions, meals and lodging are provided. Participants receive a travel stipend and schools are reimbursed for the costs of substitute teachers. The workshop is listed on the Iowa Department of Education Calendar and brochures are sent to teachers and directly to the principal of every school in the workshop target area.

Each school in Iowa is served by one of fifteen Area Education Agencies (AEA). The science consultant of each AEA has been familiarized with the GLOBE Program and given a GLOBE Introduction Video. These videos are available for free checkout by any teacher or administrator in each AEA.

IAS encourages teachers to form school or district GLOBE teams. Teachers are encouraged to attend the workshop as a group and to recruit new GLOBE participants for future workshops. Teachers are rewarded for recruiting new team members with free classroom resources. Currently, any teacher who recruits a new GLOB teacher is sent a free copy of WOW: The Wonders of Wetlands Activity Guide from Project WET. IAS also works with interested school districts to develop a teacher training plan and holds workshop spaces open for teachers from participating districts.

Classroom Support

GLOBE Workshop participants are sent a thank-you letter immediately following the workshop. These letters often include a small gift (GLOBE Notebook) or copies of photos from the workshop. Teachers are reminded that the Education Director is available to help them by phone, email or class visit. Trained teachers are added to the GLOBE Iowa Listserve. The listserve is used to send monthly updates on the GLOBE Program, state and national professional development opportunities and sources for GLOBE equipment grants. Updates also include information, tips and success stories from Iowa GLOBE teachers. At least twice a year educators in the listserve are asked to share their GLOBE stories and experiences. With each correspondence teachers are reminded that the Education Director is available to assist them and asked for ideas on how to improve the program.

The Education Director maintains the IAS Partnership GLOBE Website (www.uni.edu/~iowawet/globe.html). The website contains all information needed for a teacher to attend a workshop, links to Iowa specific sites related to each protocol, photos from each Iowa workshop and other information requested by participants. A list of the sources and prices of the GLOBE equipment used by teachers in the GLOBE workshop is an example of a web feature requested by teachers. Teachers have also requested a list of equipment funding ideas, protocol frequency charts and tips, and the workshop schedule.

The IAS owns and loans out seven GPS units, 6 soil color charts and beginning in the fall of 2002, 10 plant color charts. The Education Director is available to make classroom visits and will bring any requested protocol or activity kit with her to a visit. The Education Director is most often requested to lead the thermometer (why do we have protocols) activity, private computer support sessions for teachers, Incredible Journey from the Project WET guide and assisting students in entering data or other GLOBE website features.

In September of 2001, the Education Director used the GLOBE database to find all the Iowa schools that had reported Atmosphere data. The Academy sent a set of 6 cloud charts and a cloud poster to each teacher who had reported Atmosphere data for two years or regularly since the teacher's GLOBE Certification. A letter accompanying the charts thanked the teachers and students for their contributions to GLOBE.

Iowa GLOBE Stars

IAS began its own recognition program, modeled after GLOBE Stars, before offering its first workshop. In December and May a letter, certificate and press release are sent to the principal of any school that has reported data to GLOBE in the last six months. The letter congratulates and thanks the school for its participation in the GLOBE Program, highlights one or two ways in which GLOBE student data assists scientists and asks the principal to share the certificate with the GLOBE teachers and students in the school. The letter may also include how a GLOBE protocol relates to an Iowa issue. For example, the Iowa DNR produced a land cover map of Iowa using LANDSAT that would be improved if more Iowa schools participated in the GLOBE Land cover protocols. Schools receiving the letter are also highlighted on the Iowa GLOBE website. Schools that report for five semesters receive a "5th Award" Certificate. In spring 2004,

the Education Director plans to create a special award and prize as schools begin to receive tenth awards.
The letter and certificate program may be one of IAS's most successful teacher support efforts. The number of schools receiving this award goes up each semester. Many teachers have emailed or called expressing that the principal letter was extremely helpful to them in gaining recognition from administrators for their GLOBE classrooms. Some schools have had assemblies to present their certificate and some teachers have been offered support in purchasing equipment after receiving the letter.

Advanced Workshops

After phone and email assistance, additional training in GLOBE is the highest form of support requested by Iowa GLOBE teachers. In response, IAS added Advanced Training to its list of goals and formed a plan to offer two advanced training opportunities per year. Funding for the first Advanced GLOBE workshops was obtained in November of 2001 and the first two workshops were held in May and June of 2002.

The Advanced Workshops were designed to accomplish multiple outcomes including:

- Training on GLOBE advanced, special and new protocols
- Strengthening of statewide GLOBE teacher network
- Review of protocols from basic workshop
- Involvement of local scientists
- Collection and reporting of GLOBE data
- Implementation and integration planning.

The first two workshops were "Phenology and Landcover Advanced Training" and "Advanced Atmosphere Training". The partnership's first paper newsletter was designed to inform teachers of the events and introduce them to the concepts that would be focused on in each. Two of the articles from the newsletter are available at: www.uni.edu/~iowawet/globe/advanced2.html. The most difficult aspect of planning the advanced workshops was timing them so that a critical number of teachers could attend. The first workshop had 12 participants and the second had 14. Participants in the Phenology and Landcover training held their own mini-MUC-A-Thon at a state park and reported their data to GLOBE. This event seemed to be especially meaningful to teachers and plans are being made to make MUC-A-Park a regular event at future advanced workshops.

Response from participants was overwhelming in support of future advanced training events. Topics for each event will come from the GLOBE teachers. Funding is currently being sought for a 2003 advanced workshop on student investigations and research projects using GLOBE. As a "prelude" to this advanced workshop the IAS partnership will sponsor a school collaboration project this fall to make the change from autumn to winter in Iowa by asking each Iowa GLOBE school to record and report seasonal change markers as they happen.

Support from Partnerships and Networking

The Education Director actively seeks outside support for GLOBE classroom implementation from local and state sources. This includes financial support such as, 38 classroom start-up grants of $500 each provided by the Roy J. Carver Charitable Trust to public school teachers attending a basic or advanced workshop in 2002. It also includes providing free supplementary instructional materials on the Mississippi River System from Iowa Public Television and on using maps from the USGS regional office. Whenever possible IAS partners with other programs that serve and train teachers.

Conclusion

The Iowa Academy of Science will continue to offer its teachers a variety of support measures, to include teachers in planning teacher support and to actively encourage other local organizations to support GLOBE teachers.

Education and Implementation Panel Report:
Mentoring/Follow-up, Data Reporting and Retention Support

Programme Implementation and Support in New Zealand: The Role of Issues Based Learning Communities.

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Introduction

The GLOBE programme was established in New Zealand at the end of 2000 with the first teachers being trained in January 2001. Over the past 2 years of national implementation 100 teachers representing 70 schools (3% of the national total) have been trained within the programme. This community of schools now displays a range of implementation levels and strategies.

The GLOBE programme has been positioned within the New Zealand national curriculum as a part of the Environmental Education curriculum, though retaining significant links to the Science, Math's, Social Studies and Information Technology curricula. Part of the training programme presented to teachers focuses on implementing the programme so that teachers can meet their curriculum requirements within the "Guidelines for Environmental Education in New Zealand Schools" a document published by the Ministry of Education in 1999.

The educational framework applied to the implementation strategy used for the programme in New Zealand is one of action learning where students are encouraged to learn by doing and to also implement learning in action. To support this framework, schools are encouraged to centre their activities within the GLOBE programme on identified local, regional, national and/or international environmental issues. These issues, the questions they raise and the activities carried out by the students, form the basis of student learning communities, which can be local, national or international in nature. These learning communities are further supported by partnerships with local, national and international environmental and science experts and other interested parties.

The Education Landscape

New Zealand, a country of 270,000 square kilometers has a population of 3.8 million people, 80% of which live in cities. This population is made up of a variety of ethnic groups including New Zealand European 74.5%, Maori 9.7%, other European 4.6%, Pacific Islander 3.8%, Asian

and others 7.4%. The country has 2700 schools in the compulsory sector, the majority of which are in rural settings with 3 or less teachers. Schools are designated either as Primary, catering for students in year 1 through 6, Intermediate, years 7 and 8 or Secondary, years 9 through 13.

Typically, children start their school career on the day they turn 5 years old, though by law they do not have to start till they turn 6. All New Zealand schools work to a national curriculum comprising of 7 essential learning areas; Health and Physical Education, Language and Languages, Mathematics, Science, Social Sciences, Technology, and the Arts. The curriculum statements for these learning areas contain achievement objectives for each of the 8 levels of the national curriculum. Cutting across these learning areas are a number of integrated learning initiatives such as environmental education and information and communication technology.

The administration and management of the national curriculum including, what will be taught, how it will be taught and the choice of instructional material and approach, is devolved to the individual school and the schools governing body, the Board of Trustees. The schools Board of Trustees is an elected body from the local community. The quality of educational programmes presented to students is monitored by the Education Revue Office, a central government agency which visits schools on a 2 yearly cycle, or more often if deemed necessary.

New Zealand schools operate on a 4, 10 week term year, starting at the end of the southern hemisphere summer, typically the 1st of February. The academic year runs through the winter till mid December. There is a 2 week break at the end of each term with a longer 6 week break over the summer starting typically on the 15th of December.

Programme Design

Educationally, the GLOBE programme has been presented to schools in such a way that the programme offers a solution to teachers felt needs. At the end of 1999, New Zealand schools were introduced to the Ministry of Education's "Guidelines for Environmental Education in New Zealand Schools", a new integrated curriculum learning initiative. In this statement schools are asked to develop learning experiences that engage students in learning **In**, **About** and **For** the environment with special emphasis on the concepts of; interdependence, sustainability, biodiversity and personal and social responsibility for action. The GLOBE programme in New Zealand has been presented to teachers in such a way that if they implement the programme and continue working within the programme they will meet the requirements of this initiative.

To support this aim, during teacher training workshops, as well as being taught basic environmental science and being trained in GLOBE measurement protocols, teachers are given professional development in the environmental guidelines for New Zealand schools and shown how to implement the GLOBE programme to meet the requirements of this initiative. Secondly, an evening session of the training is devoted to the identification of local, regional, national and international environmental issues which students may focus on as a basis for involvement in the GLOBE programme. Local, regional and national environmental scientists, as well as and any other interested parties are invited to this session and are encouraged to talk from their own perspectives about the environmental issues that they see as important.

Students are encouraged to take an environmental advocacy approach to the programme, identifying one of these environmental issues as a starting point for their investigations. In this way students can situate their learning in a meaningful and authentic context which gives reason to their activities, increasing the chance that they will remain involved in the programme. To add further support to this framework teachers are further asked to identify other potential collaborators or members of the learning community they are establishing. By clustering students who are interested in a particular environmental issue, either from other classes at the school or from other schools linked via the GLOBE website it is hoped that schools will be further supported in their activities.

Structurally, the national implementation strategy for the GLOBE programme in New Zealand has focused on the development of a cell based infrastructure designed to maximize teacher retention and programme support, clustering primary (years 1 – 6), intermediate (years 7 – 8) and secondary (years 9 – 12) schools together in geographical clusters. This approach has led to the establishment of 11 regional clusters of teachers and schools. Schools within these clusters share ideas and solutions to problems, interest in local environmental issues, equipment and resources and expertise. As the programme develops students from GLOBE primary schools will flow on to GLOBE Intermediate schools and then GLOBE Secondary schools with the opportunity to continue participating in the programme throughout their schooling.

From its inception, GLOBE New Zealand formed strategic partnerships with 2 national Crown Research Institutes, the National Institute of Water and Atmospheric Research (NIWA), and Landcare Research. Representatives from both of these organizations sit on the Reference Board for GLOBE New Zealand and interact with the Country Coordinator on a regular basis. At a regional level Regional Councils are invited to take an interest in the activities of GLOBE schools. When teacher training workshops are run representation form all three of these sources is invited to take part and to make links with schools and teachers.

School Recruitment

An initial planned implementation strategy exists for offering all schools in New Zealand the opportunity to become involved in the programme over the first 2 years. The focus for the first year of the programme was enlisting schools in the North Island with the focus of the second year the South Island.

Teacher training workshops are advertised in the national education gazette, the official government magazine to schools. As well as this a letter of invitation is sent to all schools in the geographical region of the intended training site. One 4 day workshop is held in every set of school holidays and others are scheduled during term time as Thursday – Sunday courses, taking 2 days of school time and 2 days of teacher time. No teacher release funding is associated with the courses, schools need to cover the cost of release teachers from their own budgets.

Schools are asked to register teachers for the training workshops which are free for the first teacher from any school. Teachers may attend on a daily basis, or if they travel for over an hour to reach the workshop venue, on an overnight basis. The second or consequent teacher from any school is charged for the workshop at a cost recovery basis.

Additional to this registration, schools are asked to register the school into the programme. As part of this process the school principal and chairperson of the board of trustees sign a contract to implement the GLOBE programme into their school for at least 2 years. The contract points out the schools responsibilities in supporting the teachers in the implementation and embedding process of the GLOBE programme and also lists the equipment and support the school will receive as part of the programme. In this way the teachers in the school trying to implement the programme can be certain that the school management and administration support their actions.

Teacher Training

Most teacher training courses are 4 day workshops covering the GLOBE enquiry areas of; Atmosphere, Hydrology, Soils and Landcover. In some instances these courses may be split into two, 2 day courses. In the first year of programme implementation a variety of workshop models was trialed and the 4 day format has proven to be most effective in the long run. The teacher training workshops also contain sessions on environmental issues, school programme implementation and website use.

Programme Support

As part of the contractual arrangements for schools entering the GLOBE programme in New Zealand they get the support of the GLOBE staff in New Zealand. This support includes email and phone contact with the country coordinator as well as support and quality control visits. The form of the support given to schools has so far included:

- Email contact for problem solving and the sharing of innovative solutions on a needs basis. Most enquiries are turned around within 24 hours. In addition a schools update is broadcast at least once per term or more often if deemed necessary.
- Phone contact for solving website competence and confidence issues. Most often the teacher and country coordinator work through the website at the same time while talking on the phone.
- Follow up visits. All GLOBE schools receive a follow up visit for support as well as quality control. While visiting the country coordinator may work with students in the classroom, run a staff meeting at the end of the school day for staff who have not trained in GLOBE, run a school community meeting in the evening, or all three!

A final and fundamental approach to programme support is the establishment of Issues based student learning communities. The role of the country coordinator is to act as an advocate for these environmental issues based projects and to make teachers and students aware of them and to encourage them to become involved. Three projects are currently being established in New Zealand for students to participate in and more are being considered as the community of GLOBE schools increases. The current projects are

- The Cloud Sat project, in conjunction with Colorado State University. A project that is seen as accessible and achievable for all schools and at all levels.

- Mainland Island Rehabilitation Project, in conjunction with the University of New Hampshire and Landcare Research, a New Zealand Crown Research Institute. This

project aims to link GLOBE students into a current research project looking at monitoring the rehabilitation of mainland ecological islands. Students will ground truth biodiversity changes over time in areas of native forest that are being managed as mainland islands to exclude exotic pests. This work follows on from successful work done by the New Zealand Department of Conservation in establishing exotic pest free reserves on several offshore islands around New Zealand. The work by students will be correlated with satellite imagery being studied by the University of New Hampshire.

- The Waikouaiti Estuary Management Project. This project links Karitane and Waikouaiti schools with the Otago Regional Council and a local community action group in monitoring and developing a management plan for the local river and estuary system. The schools are involved in environmental monitoring as well as a riparian replanting scheme to improve the quality of runoff into the river.

Summary

Right from the inception of the programme for the New Zealand educational situation, the GLOBE programme has been presented to schools as a high level learning opportunity for students where they can become involved in meaningful learning within an extended learning community. The educational theory and philosophy, curriculum links, structural implementation plan and strategic partner base for the programme are all designed to allow this to happen. As the programme nears the end of its second year of national implementation there are signs that some schools are realizing the potential of the programme and becoming involved in these communities.

Education and Implementation Panel Report:
Mentoring/Follow-up, Data Reporting and Retention Support

GLOBE in Croatia: Program Support – Retention of Schools/Teachers

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After six years of GLOBE implementation in Croatia there are some aspects with which we could be satisfied and proud of, as well as some other which make us worried and not so pleased with. As regards the latter aspect the question of retention of schools / teachers is one of the issues. Present situation is: Out of 111 Croatian GLOBE schools, 69 make regular reports, 24 haven't started yet, had been reporting in the past.

What were the reasons for interruption of data reporting in 18 schools and does that mean stopping of all GLOBE connected activities in those schools?

I was investigating that problem again during May and June this year, as well as on several occasions during recent years. It appeared that there might have been some technical reasons for stopping the data reporting, e.g.: instrument shelter, or some instruments have been broken, Internet connection has been disabled.

The other group of reasons is always related with GLOBE teachers:If there is just one GLOBE teacher, and he/ she is absent on temporary or permanent bases or in other way disabled for the organization of the data collecting and reporting, GLOBE program stops. We had two examples when older (16 - 17 years) GLOBE students have continued with data reporting without assistance and supervision of GLOBE teacher for several months. Of course, this just couldn't last longer without real teachers' support. *All the above mentioned examples illustrate that GLOBE teacher is the most fragile and most precious element of GLOBE structure.*

Further research of "*have been reporting in the past* school category", revealed that in some cases teachers did not get sick or did not leave the school but had stopped working in GLOBE. Why? All possible reasons could be summarized in one statement: They did not get enough support or recognition for their enthusiastic work. Let's face the fact: GLOBE teacher has to be enthusiastic. But, enthusiasm could get exhausted or spent in time. GLOBE teacher has more work to do – that is for sure. If we put this fact on one side of balance, there should be enough "weight" to put on the other side, in order to keep him/ her going. That could be greater satisfaction or pleasure in work, recognition by others, higher self esteem, fulfilling of personal interests and ambitions. So, if there is enough weight on that, other side of balance, we could keep the teacher in GLOBE for many years. In that sense Chief scientist's letters of recognition play very important roll and represent great contribution to GLOBE implementation success.
In order to support and encourage teachers, we organize events/ situations where Croatian GLOBE teachers can meet at least two times during one school year. Ministry of Education and

Sports organizes these meetings, which are the combination of TT (learning of new GLOBE protocols, refreshing old knowledge, science lectures, field work, didactical innovations – learning activities, workshops for improving computer skills and communicational skills) with symposium type of meeting (experience and good practice exchange, discussions on chosen topics or actual questions). We place a lot of attention and efforts in two aspects of these meetings: teachers must feel that the participation was beneficial for them in terms of their regular subject teaching. In addition they should experience good, comfortable and friendly atmosphere. Therefore we are very open for their suggestions concerning future meetings and in planning the agenda for each of the meetings.

Decision on teacher's attendance of the meeting is subject of his/ her own will, as well as head master's readiness to cover travel expenses. Those head masters, who accept and value exceptional status of GLOBE school, usually do not make a problem out of it.

The third occasion for meeting and presentation of individual school results, are annual GLOBE students' & teachers' conferences. The main aims of the conferences are to encourage the use of GLOBE database and GLOBE measurements in students research projects. Schools' GLOBE teams, which carry out only data collecting activities, are usually "fed up" after certain scope of time. Consequently the relevant activities cease to exist.

The conferences are financed by the Ministry of Education and Sport, which unfortunately implies limited number of participants (up to 200). Only active schools are eligible to be represented by one teacher and three students. More representatives per school are accepted if the school covers their expenses. An invitation for annual conference is considered to be a credit and motivation, both for GLOBE teachers and students. Certain numbers of schools receive awards for successful implementation of GLOBE activities, for exceptional presentation of their work in GLOBE (posters and computer presentations), for research project or for winning GLOBE competition. Those awards contribute to GLOBE teacher and students recognition within the school and in local community. According to teachers, students are keen to participate in GLOBE conferences due to the low level of pressure comparing with other similar competitions. Therefore, there is general problem of selecting just three students per school.

Very important factor in sense of retention is also the program image. As long as GLOBE program is presented in public in an affirmative way, the interest for it grows. After six years of hard work in the field of marketing, we do not have to draw attention of new schools – to put extra efforts in recruiting new teachers. Many teachers are familiar with the program and they join the preparatory activities, which are organized once a year. At that point, the head masters new candidate schools are able to understand that participation in GLOBE is privilege rather than just obligation and extra work. Once they see it as a privilege and good contribution to the school image, the procurement of necessary equipment, Internet access and allocation of funds for GLOBE teachers travel expenses, do not stand as significant problem any more. Those head masters usually take care to provide GLOBE training for more than one teacher, which is very important step in retention insurance.

Student Research and Collaboration

Education and Implementation Panel Report:
Student Research and Collaboration

Comparing and Measuring the Productivity of Two Bays Worlds Apart: A student/teacher collaboration between cities on Mobile Bay, Alabama and Taganrog Bay, Russia

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Introduction

This K-12 student/teacher-based project addresses the need to reinvigorate local government agencies with a coordinated management strategy for the use and protection of significant water resources – the Taganrog Bay in southern Russia and the Mobile Bay in the southern United States. Through an on-going collaboration with students and their teachers in the Mobile Bay watershed in Alabama and their counterparts in southern Russia, this project will empower decision-makers of today and tomorrow with knowledge about their local environments and a comparable study area from around the world. These students and their teachers will become part of the International GLOBE Program -- a hands-on science and education program focusing on Earth system science with more than 10,000 schools in more than 95 countries participating.

In this project, existing GLOBE schools will be strengthened and new partnerships between GLOBE in Alabama Schools and Rostov region GLOBE Schools will be created. Project students live and attend school along the shores of Mobile Bay and Taganrog Bay watersheds. These students will investigate both their own and each others home waters and define the primary productivity of these waters. By participating in this project, these American and Russian students will learn standard protocols needed to collect water samples from around both bays. They will compare their findings using the collaborative infrastructure provided by GLOBE including its state of the art web-based data collection and analysis applications. In addition, the students will use STELLA software, a computer based modelling and simulation program, and Geographic Information System (GIS) technology to learn how changes in the seasonal composition of the waters in the bays impact productivity. This will provide knowledge of the health and the economic vitality of each bay. Finally, the students will share their knowledge and participate in discussions with local government agency officials for constructing possible scenarios for future “sustainable” development practices and resulting management plans for each region’s growth and vitality.

Program Thrusts

There are three main thrusts of this proposed project. First, GLOBE students/teachers will use cutting-edge information technology, mathematical models and a professional data collection approach to investigate and publish-for-public-access data about environmental conditions and economic development of Taganrog Bay and its watershed along with the scenarios of its future development. The same type of information about Mobile Bay will be published to compare the data and development scenarios of both places. The web site developed by the GLOBE Program (www.globe.gov) will serve as the communications tool for this effort between schools, teachers and students who participate in GLOBE program in the Rostov Region of southern Russia and in the State of Alabama. Second, the extensive communication capabilities of a web-based forum are planned for use in discussions of the present environmental and economic development in each Bay and will seek to elicit suggestions for ways to improve these conditions. We will conduct regular web chats with involved individuals from both countries. Third, local government officials will participate in discussions of the environmental conditions and economic development of both bays by using the existing sister-city partnership between the City of Rostov-on-Don and the City of Mobile. Up-to-now, the exchange of governmental sister-city delegations has focused mainly on cultural and business topics. We will use our contacts with local environmental protection agencies to help reorient this partnership to the comparison of similarities and differences of the environmental conditions and economic development of both bays watersheds using the GLOBE applications online.

Why Here, Why Now? .... Why these two Bays?

Through this project, existing schools in the GLOBE program will be strengthened. New partnerships between GLOBE in Alabama Schools and Rostov region GLOBE Schools will be created and sustained. Project students live and attend school along the shores of Mobile Bay and Taganrog Bay. These students will investigate both their own and each others home waters and define the primary productivity of these waters. By participating in this project, these American and Russian students will learn standard protocols needed to collect water samples from around both bays. They will use the Internet to compare their findings using the collaborative infrastructure provided by the GLOBE Program including its state of the art web-based data collection and analysis applications. In addition, the students will use STELLA software, a computer based modelling and simulation program, and GIS technology to learn how changes in the seasonal composition of the waters of the bays impact productivity, providing knowledge of the health and the economic vitality of each bays.

Conclusion

Bay-to-Bay Project students will share their newfound knowledge and awareness of factors affecting the Mobile Bay and Taganrog Bay's overall health. They will be prepared to participate in discussions with their local government agency officials for constructing possible scenarios for "sustainable" development practices and resulting management plans for each region's growth and vitality. The enhanced academic and workforce skills these students will gain will make them part of the vanguard of citizenry with the necessary science, math and technology skills to fuel the economic growth of their respective home areas.

Education and Implementation Panel Report:
Student Research and Collaboration

Joint Hydrology Research Project in the Middle East (Bahrain, Jordan and Lebanon)

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Participating Countries:

The Kingdom of Bahrain	**Jordan**	**Lebanon**
20 students	20 students	53 students
One teacher and the Country Coordinator	Two teachers	Five teachers
One School	Two Schools	Three Schools
Five volunteers from Al Malkeya Rovers	One volunteer	

Duration of the study

March to June 2002

Study sites:

1-Industrial coast; 2- Touristic coastal area; 3-Urban coastal area; 4 –Eco –protected coastal area

Goals:

-To conduct a study comparing the seawater quality in the Arab World (Arabian Gulf, The Red Sea, and The Mediterranean Sea).

-To develop the scientific and technological awareness among students for better educational research.

-To determine the effect of pollutants, such as sewage and industrial waste, on the seawater.

Introduction

As a result of the first collaboration between Jordan and Bahrain in which Miss Heba Jaber, GLOBE trainer in Jordan, was sponsored by GLOBE to help with the training in the first Training Workshop in Bahrain, Charlie Kellett, Senior International Analyst from GLOBE –HQ suggested that we utilize this opportunity at the workshop to develop a special research project. It was agreed that the most feasible Investigation Area would be Hydrology.

Planning Process

-Further development in this area resulted in the inclusion of Lebanon, so that the study could cover the main bodies of water in the Middle East Region: the Red Sea, Arabian Gulf and the Mediterranean Sea.

-As a conclusion, it was agreed to conduct a joint workshop involving students from Bahrain, Jordan and Lebanon. This workshop was conducted in Aqaba, Jordan at the Red Sea.

-After the students were trained and briefed on the goals of the study, each group started to collect samples and take measurements in their countries.

-Data collection continued from March to June, 2002.

-By the beginning of July a regional conference was held in Lebanon, in which the results of each country finding were presented and discussed by the students.

-GLOBE Egypt participated as observers.

Table 1: Comparison of results from the participating countries

Areas of comparison	**Lebanon**	**Bahrain**	**Jordan**	**Common Factor**
Geographical Areas	Mediterranean Sea	Arabian Gulf	Red Sea	
Duration	March-May	April-June	April-June	April-May
Study Sites	Industrial-Touristic-Urban	Touristic-Protected Reserve	Touristic-Industrial	Touristic areas
Protocols	Temperature Transparency PH GPS	Temperature Transparency PH Salinity GPS Dissolved Oxygen Conductivity Alkalinity Nitrate	Temperature Transparency PH Salinity GPS Dissolved Oxygen Conductivity Alkalinity Nitrate	Temperature Transparency Salinity PH GPS
Measurements Kits	Transparency tester Hydrometer pH pen Mercury thermometer	Secchi desk Tester Salinometer pH pen Mercury thermometer Conductivity meter D.O kits	Transparency tester pH pen TDS pen Mercury thermometer	Transparency tester pH pen Mercury thermometer
Findings	**Lebanon**	**Bahrain**	**Jordan**	**Common Factors**
Positive	Moderate Average temp. High transparency (except in the Karantina area) pH 7.8-8.2	High transparency High Salinity – 53ppt (attracts certain kind of fish) Avg.pH 8.4 Moderate Oxygen level	High transparency High dissolved oxygen Moderate Nitrogen Avg.pH 8.3	High transparency High pH
Negative	In the Karantina area which is near a river delta the transparency was low, salinity was low, pH 7.3	High salinity is fatal to some kinds of fish. High temperature	High Salinity High water temperature High conductivity High alkalinity	High Salinity

The Advantages and Disadvantages of the Study:

Disadvantages:

- Physical distance between the three countries.
- Some of the schools did not have appropriate measurements Kits.
- Due to the lack of marine transportation most of the observations were done onshore.
- Some schools had to use self-provided measurement kits, which were not accurate as GLOBE kits.
- The discussion of final results should have included scientists or experts' hydrology to give a professional evaluation of these results.

Advantages:

- The students gained a lot of insight and learned how to conduct a collaborative scientific research project.
- The students discussed the weaknesses of their methodology and the importance of avoiding such error in the future.
- The study enabled us to better understand not only our marine environment, but also marine environments of the other participating countries.
- This study was very beneficial for the students as they were given the chance to exchange educational and cultural ideas between one another.

General Recommendations:

1. Establish GLOBE Scientist committee in each of the four participating countries, including university professors, environmental experts and teachers, and link them through a regional network.
2. Involve more GLOBE schools in the Student Inquiry process.
3. Prepare in each country more detailed criteria for new research (MUCathon) and submit proposals by end of August 2002.
4. Consult experts on the findings of the study in order to make recommendations to the local authorities in each country.
5. Establish a GLOBE Arabia Website, that would serve as a communication platform for GLOBE students in the Arab Countries.
6. Form a preparatory committee for the GLOBE Arabia project, including students and teachers from each country.
7. Source local suppliers for chemicals and measurement devices in each of the four countries.

Specific Hydrology Recommendations:

1. Prepare new criteria for the hydrology which will be continued on the same basis from March to June 2003.
2. Publish the findings of the study on local level.
3. Ensure that the measuring equipment used to test conductivity is appropriate and reliable for seawater.
4. Recommend GLOBE Egypt to study the characteristics of water along the Nile River.
5. Allow participating students to correlate results of the study and provide analysis.
6. Involve local scientists in the analysis of the data collected.

Conclusion

1. Water in the Mediterranean Sea was warmer than water in the Arabian Gulf and Aqaba Gulf.
2. The average pH of the three bodies of water was 8.3.
3. Transparency was low and the turbidity was high in the Red Sea and the Mediterranean Sea in the industrial areas.
4. In Bahrain there are exposed water and sheltered water; the salinity was high in the sheltered water and low in the exposed water.
5. The positive and negative findings affect the fish life, coral reef and specify the kind of marine life.
6. The high salinity in the Arabian Gulf kills some kind of fish and on contrary it lets some kind of fish grow thicker (like Safi, grow more in Bahrain and less in the north of Arabian Gulf, like Kuwait and Iraq).

In Conclusion, this study was very beneficial for the students as they were given the chance to exchange educational and cultural ideas between one another.

Education and Implementation Panel Report:
Student Research and Collaboration

GLOBE and Student Inquiry: What It Looks Like and What It Takes

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Introduction

> It's hard, it's not easy, it's a little bit scary… but I've really seen amazing results with my students. They're willing to take risk, they understand the concepts better… I definitely have seen big improvement… in their thinking, in their ability to take ownership of their learning.
>
> *- a teacher describes student inquiry with GLOBE*

Many national and state standards recognize an understanding of the process of scientific inquiry as an essential component of science learning and literacy (AAAS, 1989, 1993; NRC, 1996; Olson & Loucks-Horsley, 2000). Inquiry-based science instruction—in which students conduct research related to a driving question of interest—helps students to understand what it means to "do science" and conduct scientific sense-making, as well as promoting deeper understanding of scientific concepts and engaging students in grappling with the "big ideas" in science (Bransford et al., 1999).

The GLOBE program offers outstanding opportunities for students to collect authentic data and to interact with scientists that are using that data for important research. Using GLOBE for student inquiry builds on this foundation, with students conducting their *own* research based on the data they collect, often pursuing questions of relevance to local environmental issues: looking at the impact of local farms on the quality of water in a rural neighborhood stream, or investigating pollution at an inner-city hydrology site. GLOBE teachers who promote inquiry-based approaches in their classroom report that these projects give students ownership over the data they collect, promote a deeper understanding of the science behind the data, and support new custodial relationships of students with their environment: all important goals of the GLOBE program, and critical elements of science education.

Nevertheless, student inquiry with GLOBE is not yet widespread; many teachers are just beginning to explore the possibilities, and to grapple with the challenges of using this approach in the classroom. This paper describes case study examples of student inquiry and other ways to make GLOBE data relevant to students, summarizes what it takes from teachers to make it work, and suggests some ways that the GLOBE program and its partners can support learning methods that promote deeper student engagement and environmental awareness in GLOBE classrooms.

Methods

This paper is based on data from a series of site visits and interviews conducted by SRI as part of the year 7 GLOBE program evaluation. In spring 2002 we interviewed a total of 13 teachers. 3 of these were site visits that included observation of GLOBE activities as well as interviews with teachers and other school personnel to learn more about their experiences and outcomes as they conducted student inquiry projects with GLOBE. The remaining 10 teachers were interviewed over the phone. This paper also makes use of site visit data from prior years' GLOBE evaluations.

Our sample was drawn from teachers whose classrooms were recommended to us by partners, PIs and other sources as successful examples of student inquiry or other personalized student activities using GLOBE data. We used a handpicked rather than random sample because of the small percentage of GLOBE teachers using the program for classroom inquiry to date, and because our goal was to learn from particularly successful implementations. The sample also included teachers who considered using GLOBE for student inquiry but experienced challenges as they tried to implement this approach in their classrooms. We also sought to include teachers from a number of different community and educational contexts to understand the range of approaches they used to make GLOBE relevant to their diverse populations of students.

Snapshots of student inquiry and personal relevance using GLOBE data

Projects designed to enhance the personal relevance of GLOBE data will necessarily take a different shape for students in different contexts: environmental awareness in the inner city has different goals and challenges than in farming communities, for example, and GLOBE activities can be designed to build on the various forms of connection that students from different cultural backgrounds may feel to the land. The examples that follow illustrate a variety of types of projects that GLOBE teachers used to enhance student engagement and understanding by connecting the data to issues of local or cultural importance in varied contexts, and suggest important benefits to students and teachers from this type of GLOBE use.

In the inner city: GLOBE is used in a magnet program at Forest Heights Elementary in Baton Rouge, a school serving an African American community in the city with 96% of students on free/reduced lunch programs. 4th and 5th grade students collect atmosphere data daily, and hydrology data weekly. Students have conducted projects related to trends they noticed in their atmosphere data, comparing seasonal changes in their region to other GLOBE schools and reporting the results. More powerfully, visits to the GLOBE hydrology site located 10 minutes from the school were the first time many of these city students had experienced a wooded

environment; questions they raised as they visit the site to collect data led them to conduct extended research projects on their local ecosystem. In addition, looking at fluctuations in their pH readings over time brought up questions about local pollution. At the time of our site visit in spring 2002 these questions were triggering an investigation into pollutants in the local watershed: a new avenue of investigation for the teacher, and one which offered opportunities to build very new levels of environmental awareness for students who previously interacted little with the natural world.

According to teacher Jill Calloway, the students now have a much deeper understanding of the concepts behind the GLOBE measurements: they don't just know how to measure pH, they understand its relationship to the ecosystem, with plants and animals able to live only in a certain range, and are aware of pH fluctuations and their environmental results. In addition, she says, student responsibilities for scientific investigation have helped them become more engaged in science class, they "feel respected as humans and learners," and they feel empowered to think and solve problems. Said the school principal, "For children of poverty, thinking is *the* most important skill."

In a rural community: Stark County—a district serving a low-income dairy-farming community in rural Ohio—has found GLOBE-related inquiry projects to be a good way to promote students' awareness of local environmental issues, and to engage parents in their children's education by demonstrating the link between school and their environmentally-based livelihoods. As of the date of our visit in 2001, collaborations in the district were being planned with local scientists to enlist students and their GLOBE data to inform land use proposals and the discourse around a local landfill controversy, to provide required water quality data around a recently-built power plant, and to measure the impacts of local dairy farms on stream water quality. In addition, a 4th-grade class builds analysis into their daily atmosphere data collection, making daily weather predictions based on the data they collect and comparing to those on weather.com. The class really *understands* weather, says the teacher: "we're the only class in the world that cheers and boos the barometer!"

With Native American students and teachers: Heritage College, a GLOBE franchise in Toppenish, WA, offers a GLOBE-based practicum for pre-service teachers in a town known as a motherland for the Yakama Tribe. A challenge for instructor Pat Falco is to offer an engaging and accessible program for pre-service teachers with little background or confidence in science. The program links GLOBE with Native American views of the land in a longterm project that teams pre-service teachers with two groups of high school students to build a garden on land leased from the tribe. Science concepts core to garden design and maintenance are introduced using GLOBE Soil Fertility Lab Kits and hydrology protocols as well as culturally relevant examples (like a demonstration of condensation led by one of the pre-service teachers that used a model of a traditional sauna house), native plant names, and discussions with elders on native views of the land. GLOBE provides a vehicle for introducing important science ideas, while the garden project puts that science to use in a real-world context that is particularly relevant and accessible for the students and pre-service teachers in Toppenish.

Student inquiry and GLOBE data reporting

Does student use of GLOBE data for their own purposes support or detract from their reporting of measurements to the GLOBE database? Interestingly, teachers we talked to generally reported that the frequency and accuracy of student reporting of GLOBE data *increased* as they began to use the data for student inquiry. When their students engaged directly with the data, teachers said, they built a much stronger awareness of the scientific process, the importance of accuracy, and the utility of the data they report for answering important scientific questions. As a result, they developed a much stronger sense of ownership and pride in the data they reported, and were more likely to make sure it was consistent and correct. Said one teacher,

> I think they realize the importance of being accurate, taking their time, and knowing that, hey, nobody can study this if the data wasn't good.

This teacher also said that GLOBE-related inquiry is improving her own understanding of the importance of consistent data entry, and motivating her to find more creative ways to make it work. She is now looking into partnerships with staff at the local wildlife preserve that serves as their hydrology site to continue data collection over the summer, hoping to extend data reporting into a year-round activity.

Overall, the examples above and those from other classrooms we visited demonstrate that student inquiry and other locally-relevant classroom activities can help to forge personal connections for students with their GLOBE data, making the meaning of the data—the science it represents, its relevance to the local environment, and its importance to the scientific process—come alive. Teachers agree that these approaches can deepen students' understanding of the science behind GLOBE, and promote their abilities to conduct and discuss scientific research. Inquiry-based approaches on personally meaningful topics can also give students a stronger connection their environment, and a curiosity about the world around them.

While GLOBE can be a catalyst for these sorts of outcomes, the teachers we talked to also agreed that there are a number of practical challenges to using these types of instructional approaches in the classroom. The following section explores these challenges, and suggests some supports that can help make these approaches feasible for a broader range of GLOBE teachers.

Challenges to student inquiry with GLOBE

Our experience in soliciting teachers for our case studies indicated that classroom implementation of GLOBE student inquiry is still in an early stage: while very positive examples exist, the practice is not yet widespread. We talked to a large number of teachers as we screened our sample who had hoped to conduct inquiry with GLOBE but had not succeeded in fitting it into their curriculum, and we interviewed several teachers who were enthusiastic about inquiry approaches but used these primarily with non-GLOBE resources. Challenges they described include the following:

Planning inquiry projects takes time. Each teacher we interviewed that was facilitating classroom inquiry had invested a great deal of personal time in developing and guiding their extended student projects. When teachers use GLOBE for data collection and reporting, they have access to detailed step-by-step instructions for conducting protocols; this is also a major focus of GLOBE training. By contrast, while some of the projects teachers conducted were based on or inspired by GLOBE learning activities and resources, most of their projects were adapted significantly to the local students and environment or developed entirely by the teacher. Teachers agreed that resources for compelling locally-relevant inquiry projects for different types of local environments would be extremely useful, including examples that describe ways that other teachers have used GLOBE to foster important connections between students and their environment.

Inquiry is often new to students. In traditional educational environments, most students have little experience asking questions and designing research to answer them; it often takes a lot of encouragement to get students to ask questions and phrase them in ways that are appropriate to scientific investigation, or to learn to work productively in teams as they conduct their research. Some teachers found it necessary to design simple activities in scientific questioning before diving into more complex GLOBE data. For example, students in one elementary school class observed the class's guinea pig and chose to design an experiment around the question, "What do guinea pigs like to eat?" Again, teachers suggested that models for these sorts of activities would be useful.

Inquiry is often new to teachers. A common theme across the teachers we interviewed was their own learning curve, a trajectory that typically began in GLOBE with standard use of protocols and evolved to exploration of more inquiry-based strategies as they saw the potential for students to take their GLOBE work to a greater depth. Some teachers spoke of the personal risk they had to face as they took their instructional strategies from teacher-centered to learner-centered, giving up some control to students and in some cases conducting projects in which the teacher didn't know "the answer". One teacher trainer we spoke with conducts classes that put teachers in the "inquirer's seat", inviting them to conduct their own inquiry and building tremendous enthusiasm for trying out these pedagogical approaches in their own classrooms.

Curriculum integration and standards integration are critical. Student inquiry implies extended exploration of a topic, which in turn places a stronger demand for integration with the broader curriculum and with other science curriculum packages that may be in use in classrooms (for example, FOSS or Ames). While some teachers reported that GLOBE is generally complementary with other curricula and with required science topics, one teacher described her curriculum mapping process as "an ever-changing thing: as I teach the things… I need to teach I pull GLOBE in and I see what works and what doesn't." Several teachers suggested that it would be helpful for GLOBE to provide a workshop or coaching on integrating GLOBE with local curriculum and standards, and to share ideas among teachers. Those teachers whose local partners had offered services like these were extremely positive about their value.

Availability of sound data can be a problem. Teachers also reported the challenge of finding consistent enough data from other schools to offer useful comparisons. One teacher said he

stopped giving students GLOBE inquiry assignments for that reason: his students would spend a great deal of class time simply in searching the database for a school with enough data to answer their research question. Another teacher said she spent evening time finding appropriate comparison schools in the database so that students could focus on their analysis. Teachers also cited lack of resources as a challenge, either the money to buy and maintain GLOBE equipment or the need for enough computers in the classroom to allow student online research.

Conclusion

The research described here implies that student inquiry and other locally-relevant strategies for GLOBE use have the potential for promoting significant gains in student science understanding and environmental awareness as well as increasing the consistency of GLOBE data collection and reporting. This paper has summarized some promising examples of these approaches, as well as the challenges and needed supports that impact their success.

Based on our interviews, the teachers that have been successful at facilitating meaningful student inquiry with GLOBE have a number of things in common. They all share a driving goal of getting students to think, believing that problem-solving skills will serve students best in the longrun. Most of these teachers are equally passionate about the goal of connecting students to their environment, helping them to build a healthy awareness and love for the natural world in which they live. Interviews consistently suggested that teachers believed strongly enough in these goals to spend personal time in developing successful activities, forging partnerships with local scientists, and the other activities that are required to make classroom inquiry work. These teachers also share a willingness to let the curriculum flow in emergent directions, following topics of particular interest to students that they believe might result in exciting new discoveries.

Currently, then, using GLOBE in this way seems highly dependent on individuals—the initiative of highly motivated and skilled teachers—and supportive situations, such as standards that map well to GLOBE topics or the curricular freedom to try out new approaches in the classroom. At this stage, the challenge for the GLOBE program and its partners is to build on early successes by teachers like those described here to make this exciting path of GLOBE use accessible to more teachers and students in the years to come.

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Education and Implementation Panel Report:
Student Research and Collaboration

Results of GLOBE Japan Student Conference

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Abstract
We would like to report results of GLOBE Japan Student Conference in the poster session of 7th Annual GLOBE Conference in Chicago. We provided opportunity of GLOBE Student Conference to GLOBE schools for student exchange and collaboration in GLOBE activities. That conference was held at Tokyo on 26-27th of January in 2002. In oral presentation of our conference, the students of 15 Japanese GLOBE schools presented their activities and experiences of GLOBE and environmental observation brought by GLOBE in each school, and exchanged their ideas for observation and conservation of earth and everyday nature in the poster session and table discussion of our conference. Each student gave the information of e-mail address with one another for continuous exchange. After coming back to each school, some GLOBE schools that participated in conference had the time for presentation of result of conference for the other students. We will give participants of Chicago Conference the good lessons when holding GLOBE conference for students.

Introduction

On January 26-27, 2002, The GLOBE Japan center held "The GLOBE Japan Student Conference" (JSC) at the National Olympic Memorial Youth Center in Tokyo, Japan, for the purpose of fellowship and research presentation of earth study observation activities done by the students of GLOBE participating schools. At this meeting, based on the survey soliciting students' opinions, we considered the effects that GLOBE activities and "JSC" have on the students' awareness and motivation toward the environment and environmental studies.

Problems of GLOBE Japan until Now

Eight years have already passed since the beginning of the activity of GLOBE Japan, and there have been some problems. In the beginning, how to computers are introduced to the school settings and how the schools have access to the network were the problems, but they were solved with the time. However, there are some important issues such as "How should the GLOBE be positioned in the curriculum?" "How can the observation activity be taken into the regular school activities?" and "How are the observation data utilized in educational activities in the classroom?" They are being solved by the practice initiated by the teachers of the participating schools.

New Problems and "JSC"

As GLOBE spreads, new problems have surfaced. One of such was the lack of communication among participating students. The use of internet is one of the characteristics of GLOBE, and the

students have been communicating among one another through the use of E-mail, notice board and TV conference system etc. However, they had never had a chance to communicate face to face. In order to continue GLOBE activities, communication is important to share the feeling of oneness as the students work together with the same purpose and to share their own experiences and problems.

Another problem was that the students did not have the opportunity to present the outcomes of their activities. As the measurement and observation continued smoothly and the analyzed data were accumulated analysis, the opportunity to present the result was desired. Among the pilot schools, there were some that used the opportunities of school's annual cultural festivals or whole school meetings. However, there were hardly any schools that presented their outcomes outside the school. It is meaningful to summarize one's thought and communicate it effectively to the others. In the process, students may realize the things which they never thought of. Speaking in front of the audience may motivate the students more. With the two reasons above, the GLOBE Japan decided to hold "JSC".

Method

In order to investigate the effect that GLOBE activity and "JSC" have on the students' awareness and motivation toward the environment and environmental studies, we discussed the possibility of questionnaire survey. However, considering the limitation of the survey done by the questionnaire, we tried to solicit students' opinions by asking students to write them on Post-it. Students were asked to give their opinions three times during the conference - after the opening ceremony, during the fellowship meeting and before the closing ceremony. Students were not given specific questions. They were asked to share whatever they thought about the following three subjects: (1) what they hope for the conference (we named this subject "the encounter tree"), (2) what they hope for GLOBE, and (3) what they achieved in the conference (we named this subject "the fruitful tree"). After the conference, we categorized the students' comments. As for the effect of "JSC", we compared comments for (1) with that for (3). As for the effect of GLOBE, we looked at comments for (2).

Program and the Aim of "JSC"

"JSC" was held with the following schedule:

January 26, 2002
10:00 Opening ceremony
10:40 Oral presentation 1
12:00 Lunch time
13:00 Oral presentation 2
13:30 Poster presentation / Poster communication
15:00 Measurement / observation experience activities
17:00 Orientation
17:15 Dinner / Bath time
19:00 Fellowship meeting
22:00 Lights out

January 27, 2002
07:00 Breakfast
09:00 Introduction of the GLOBE activities in foreign countries
09:30 Nature Game session
11:30 Closing ceremony

Aim of the programs of "JSC"

As mentioned in the above, the conference was held to offer a chance for the promotion of communication among students of each GLOBE school. We implemented each program of this conference from the flowing viewpoints.

* Oral and Poster Presentations:

To offer the chance for presentation by participants of each school, the oral and poster presentations were conducted. GLOBE students have never had chance to let the other GLOBE students know their experiences on GLOBE. However, they could discuss the environmental observation related to GLOBE in this conference. Moreover, they could have the time with friendly communication, especially in the poster presentation.

* Measurement / observation experience activities:

To get good relation between students and scientists, the faculty members of GLOBE Japan Center in Tokyo Gakugei University directed the learning activities of environmental science in relation to GLOBE Program as a event of this conference. Although GLOBE Program has had the distinctive feature with support of scientist for schools education, there had been a lack of direct communication of face-to-face between students and scientists in GLOBE Japan. In this conference, the students were involved in environmental science by guiding of scientists.

* Fellowship meeting:

Even if there is experience that students used e-mail and web chat for communication among GLOBE students, it is also important for students of different schools to see and talk about GLOBE Program friendly and comfortably. Because, it is expected that the communication with the Internet is more significant by face-to-face talking with relax situation. Therefore, in this conference, the participants had chance of relax talking about GLOBE Program, being guided by good facilitators.

* Introduction of the GLOBE activities in foreign countries:

Information that many countries and huge foreign students participate in GLOBE Program gives Japanese students encouragement for implementation of GLOBE activities. In this session, we introduced the staffs of GLOBE main office by showing the videotape letter including greeting from them, and let participants see videotape that was made by GLOBE main office.

* Nature Game session:

To be aware the everyday nature, the interpreters for nature learning guided participants to world of nature as woodland.

Results and Discussion

Outcomes of the GLOBE activities

There were 115 comments on "hope for the GLOBE activities." They were roughly categorized into two groups: active hope and passive hope. For example, some of the comments expressing passive hope were, "I want the teacher of other subjects rather than science teacher only, when they accompany us at the time of observation, " and "I want longer activity hours." These comments are toward the systems of school or the society. On the other hand, comments expressing active hope were, "I want to try many different observation.", "I want to clean up the river!!", and "I want to recycle cans." These comments are categorized into some groups: those

on more interests in the environment and enquiry about better measurements by experiments, such as “I want to take more measurements.” And “I want to learn more about the environment.”; those on taking action other than measurements, such as “I want to do activities like recycling.”, those on interests in domestic and international fellowship, such as “I want to establish fellowship with GLOBE friends around the world.”; and those on pride in their own GLOBE activities, such as “I want to let people know about GLOBE. “These voices of students reflect their active involvement in the GLOBE program, and it can be said that it is the outcome of GLOBE.

Significance of “JSC”

Comments for “the encounter tree” and “the fruitful tree” were fifty one and sixty three, respectively. The comments for “the encounter tree” were roughly categorized into three: (1) thirty one on the presentation and activities, (2) thirteen on the fellow ship, and (3) eleven others. When we look at each category, among (1), there were comments that express students determination toward the presentation, such as “I will do my best at the presentation.” There were others that express expectation toward the presentation by other students and the activities. As for comments on the fellowship, they ranged from “I want to make new friends.” to “I want to know more about GLOBE and natural environment through new friends.” The comments for “the fruitful tree” can be categorized roughly into two groups: one on the presentation and activities, and the other on the fellowship. Some students compared their own activities and those of others, and learned some new ideas. In their comments, they expressed that they would like to use the new ideas in their future activities. This indicates that the students are interested in continuing the measurement and observation activities. It seems that there were many opportunities to make new friends at the fellowship meeting, There were comments that they would like to continue the activities exchanging information with new friends.

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Education and Implementation Panel Abstract:
Student Research and Collaboration

What Factors Affect Grass Distribution? An Online Investigation

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Reopening the Door is an innovative online Master's in Science Education program that engages K-8 educators in authentic scientific inquiry. In Biological Explorations, the third in a six-course degree program, teachers investigate the complex phenomena of adaptation and natural selection. They begin by setting up mini biology labs in their homes, growing grasses under a variety of conditions. As the course unfolds over 12 weeks, they make predictions, gather data, and collaborate with other participants online to make meaning of their findings. In one online investigation, the teachers look at the world from the perspective of a biogeographer, considering the following questions: Can we see patterns in the distribution of grasses in regions of the globe? Can we explain these patterns in terms of the adaptations of grasses to particular environmental factors? Working within online study groups, they make, share, and discuss predictions about the global distribution of grasses on a blank world map. Next, as they closely examine GLOBE grassland distribution images, they look for patterns that explain why grasses are located in certain parts of the world. As the online discussion deepens, they investigate the possible role environmental factors play in global grassland distribution by analyzing additional GLOBE visualizations (depicting global data on precipitation, soil moisture, and temperature in January and July of one year). To bring their learning full circle, the course participants compare GLOBE data with the grass plantings they are observing firsthand in their homes. This investigation generates a series of rich and engaging online conversations that deepens participant understanding about how grasses are adapted for particular climatic conditions.

Curriculum Integration

Education and Implementation Panel Report:
Curriculum Integration

How One High School Implements GLOBE in Science Classes

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GLOBE in the required courses, Earth Science and Biology

To enable as many students as possible to become more aware of their local environment both personally and scientifically, the Science Department a Kingsburg High School in California has infused different aspects of GLOBE throughout the science courses since 1995. All students take Earth Science grade 9 and Biology grade 10, as part of California's two year science requirement. Students are introduced to GLOBE in grade 9, although most have had some contact with the program from elementary school, as the local elementary district has several GLOBE-trained teachers implementing GLOBE (all 5 Kingsburg schools are GLOBE schools in a town of 9,000 population). The Atmosphere site is maintained by students in the Earth Science classes after their weather unit early in the school year. All the students are taught GLOBE protocols in this unit and a rotating group of students in the class period during solar noon collects the data each day, and students from other class periods enter the data. Later in the year the students learn to do a GLOBE soil characterization, pH, and NPK, of local area soils during the soils unit taught in this class. Each class analyzes soils from either the atmosphere site, the land cover site, or another site around campus. In Biology, the 10th grade year, students visit the land cover site near the Kings River about 4-5 times during the school year and carry out biometry protocols at least twice and also study the macroinvertebrates in the river. This data is compared to that collected previous years. The MUC level of our Land Cover site changed after the most recent El Nino year, and then changed back a year later.

GLOBE in the elective science courses, Chemistry and Physics

The Chemistry classes analyze the water of the Kings River twice a year as a class project comparing autumn to spring chemical tests, which include, but are not limited to, the 7 GLOBE Hydrology protocols. A written report is made by groups within each class each of the two seasons. Small groups of chemistry students conduct the weekly Hydrology tests before school on Mondays, as school starts later that day so teachers can conduct meetings. Students are encouraged to include in their Kings River report an analysis of the changes in the water throughout the year, not just the autumn and spring data. Analytical Chemistry, a more advanced chemistry class, carries out the laboratory soils protocols and writes a report analyzing the results. The Physics classes study satellite imagery and use the local images we have received from GLOBE.

GLOBE in the Advanced Placement science courses, AP Biology and AP Environmental Science

Larger environmental projects are carried out by the AP Biology and AP Environmental Science classes. Advanced Placement courses are nationally-recognized courses that provide college credit to high school students who pass the national exam in May. A course outline is provided for each AP course. 10% of the AP Biology course involves ecology, and since 1988 the class has studied winter ecology in Yosemite National Park on a 5 day field trip. That field experience has branched out into a multi-seasonal study of the different life zones in the park. These students use Land Cover, Hydrology, Soils, and some GLOBE Atmosphere protocols to compare the different elevation zones, starting in the valley grasslands where we live, all the way up to 2,000 meters in the park. The AP Environmental Science class (offered on alternating years with AP Biology) does more extensive research in Yosemite, as the course is designed to study the environment. We've developed a partnership with Wawona School in Yosemite. Our students eat and sleep at the mountain school in exchange for mentoring the K-6 students in GLOBE-related activities; this has truly been a win-win relationship! We have also developed a partnership with a GLOBE school in West Virginia, which studies in the Appalachian Mountains; our students do video chats and compare biomes (our grasslands and temperate coniferous forests with their temperate deciduous forests) and cultures with this class (we took a group of West Virginia students with us to Yosemite a year ago and hope to send a group of our students to West Virginia this school year). This class also studies California central coast environments, using GLOBE ocean hydrology and land cover protocols in the area of Monterey, California. Part of that 3 day field trip involves a tour of the Monterey Bay Aquarium, which focuses on the local marine environments. This year we hope to add a trip to the Mojave Desert to study desert habitats. Each student has to report on some aspect of the environments studied as an end of year report.

Teachers and other courses involved in our environmental studies

All six science teachers at Kingsburg High School are GLOBE-trained, three of the six are trainers for the local Fresno area Partnership, and one of the three is also a GLOBE Master Trainer. Our GLOBE-related studies have not been limited to science classes through the years, however. We have had art, English, civics, agriculture, and computer classes and teachers work with us on projects involving field sketching, painting and ceramic projects inspired by field experiences, observational writing and poetry in the field, a plant identification data-base, a land use assessment, and a historical newspaper of the local area written by history students with the computer class writing it up while learning desk-top publishing.

Conclusion

Kingburg High School students are aware of their local environment.

Education and Implementation Panel Report:
Curriculum Integration

Moving From Environmental Awareness to Action in Trinidad and Tobago

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Abstract

A coordinated approach to EE in the school system of an island state requires a commitment to national policies.Infusion of EE into the school curriculum requires the inclusion of GLOBE Program EE objectives in all curricula documents.All stake holders are required to actively participate in all EE initiatives. Five major areas : Awareness,Knowledge,Skills,Attitude andParticipation should be included inany programme. Sustainable activities must be planned for successful implementation of this project.A coordinating and monitoring body is needed to support the effective management of this programme.

An Approach to Implementation of the GLOBE Program in a Small Island State

Environmental Education (EE) is fundamental to human development and is a critical component in biodiversity conservation within all sectors of Trinidad and Tobago. The National Biodiversity Strategy Action Plan (NBSAP) 2001 and the National Environmental Policy (1998), are the two major Policy documents that guide EE initiatives in the nation. EE in the national context stresses five important areas:

Awareness: Acquisition of sensitivity to the total environment and its problems. It involves a development of the ability to perceive and discriminate reality so as to process, refine and extend these perceptions and use this ability in a variety of creative ways to solve problems.

Knowledge: An understanding of how the environment functions, its linkages, how people interact and deal with issues and problems of the environment in a sustainable manner.

Skills: Development of a capability to effectively investigate and provide solutions to environmental problems.

Attitude: A disposition and acquiescence to a set of normative values and concerns for the maintenance and protection of the environment.

Participation : Acquisition of experience through utilisation of knowledge and skills to enable one to take thoughtful, positive actions towards the resolution of environmental issues/problems.

Strategic Action Plan

The strategies employed to sustain these ideals should involve:

- Introduction of EE from primary school age to tertiary level using the infusion approach focusing on the goal of providing knowledge of both local and global issues and the capacity to move from awareness to action.
- Ensuring all education programmes for schools contain environmental and sustainable development concepts.
- That all adult education programmes should include EE issues.
- That the Environmental Management Authority in collaboration with the Ministry of Education ,should be responsible for coordinating and monitoring all EE initiatives.
- Inclusion of EE issues in all adult education programmes.
- Development of an ongoing programme of public awareness through radio talk shows,TV appearances,regular articles in the daily press,community quizzes,environment exhibitions,car stickers,book marks and competitions.

Actions Proposed

A series of activities should be planned to implement these strategies:

1. Conduct an assessment of pre-school, primary, secondary and teacher training programme to determine the appropriate mechanisms for EE infusion into the curricula.EE objectives and activities should then be written into all curricula documents.
2. Based on this assessment local and regional educational materials are developed in support of EE throughout the education system.
3. Build advocacy with all Environment stake holders to develop these materials.
4. Use existing GLOBE educational materials as a basis for EE infusion in all curricula documents.
5. Lobby for further infusion of EE into regional and international examination syllabi.
6. Expand the GLOBE teacher training programme to include principals and supervisors.
7. Integrate the GLOBE Program into the science programme at the training colleges.
8. Reintroduce science in the Secondary Entrance Assessment Examination.Science and Social Studies were removed from this high stake placement examination in 2002.
9. Access information from international environmental bodies through the Internet.
10. Promote the GLOBE Program, the Environmental Education Across the Curriculum in Trinidad and Tobago (EnACT) project and other UNESCO associated projects in all schools.
11. Develop materials for EE infusion in all curriculum documents.

The EE objectives of the GLOBE Program will be written into all curricula documents. This approach will ensure that EE will not be left to the discretion of a few, but done by all.

Implementation Approach

In Trinidad and Tobago the following approach is being recommended:
1. That all Borough, City and Regional Corporations be actively involved in the GLOBE Program by providing logistical support to all schools in their area.National coordinator should make presentations at their statutory meetings.
2. That all schools make their environmental data available to all key environmental stakeholders.This requires an on-line data system to be devised.
3. That the GLOBE Program be extended to all schools over a protracted period using the adoption approach among secondary and primary schools in a given catchment area.A Secondary school adopts one or more primary schools in the area.
4. That all youth organisations be brought into the GLOBE Program.
5. That all training colleges use the GLOBE Program as the vehicle to empower student teachers in their responsibility to the environment.
6. That all community based organisations assist schools in their area in the GLOBE Program.
7. That students provide regular written contributions to the media and make appearances on TV programmes highlighting their environmental work through the GLOBE Program.

Successful implementation of these strategies will ensure that students are empowered to protect the environment in a sustainable atmosphere.

Education and Implementation Panel Report:
Curriculum Integration

E-Learning and GLOBE - The e-LSEE Project

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One of the unique aspects of the GLOBE Programme is the huge database of environmental information that has now been compiled by children from around the world. From a teacher's point-of-view, however, the enormous amount of data poses some serious questions: How can I find the right set of data? Which schools have information relevant to the topic I am teaching? How can I help both less-able and more advanced students using GLOBE data? The thinking behind the **e-LSEE** project (**e-L**earning in **S**cience and **E**nvironmental **E**ducation) was to address these questions in a way which benefits teachers across Europe - and potentially across the world.

Stemming from a meeting of European GLOBE Country Coordinators held in Santorini, Greece, in September 2000 came a determination to work more closely together across Europe. Fortunately there was a funding programme under the European Union's Socrates Education Programme that fitted our needs. Called Minerva, it was aimed at open and distance learning, linking information and communication technologies in education. And it was open to any multi-national group of non-governmental organisations in any EU or Accession country. A rapid emailing amongst us came up with a group of GLOBE Country Coordinators willing and able to put a proposal together, linking the six countries of the Czech Republic, Estonia, Holland, Norway, Poland and the United Kingdom.

We weren't all fully aware when we first put together our draft proposal that the Minerva selection process was in two parts: a first filtering based on a brief proposal, then a funded meeting to write the full proposal (on a 69-page form with its helpful 135 page guide…!) So having passed the first hurdle we met in Tallinn, Estonia, in February 2001 to write the proposal, which after a wait of several months, was finally awarded in October 2001.

Our **e-LSEE** project aims to develop a trans-national collaboration of teachers implementing the GLOBE Program in order to promote the use of ICT in teaching science and environmental education to pupils aged 8 - 16. There are five main objectives to the project:

1. to develop new resources using ICT for education in science, mathematics, the environment and sustainable development.
2. to exploit the educational potential of the on-line environmental information already collected by GLOBE students world-wide.
3. to test and evaluate new educational materials and methodologies for e-teaching and e-learning.
4. to disseminate the appropriate materials and methodologies in all European countries.
5. to promote electronic communication amongst teachers as an innovative form of trans-national educational co-operation.

The project began with a meeting in April 2002 in Prague, Czech Republic, where over 30 GLOBE teachers and Country Coordinators from six countries met for three days to hammer our the details of the project. During this meeting we agreed work-sharing arrangements and timescales, and started work on the themes that will be the focus for the education activities. Thanks to support from GLOBE-US, we also were able to discuss ways in which we could use the international database. Now, back in our own countries, the work of writing and testing the new materials has begun and we are not scheduled to meet again until the final international conference "e-Learning in Science and Environmental Education" to be held in Estonia in October 2003.

Meanwhile we have set up two websites: one to be the final site for our materials at www.globe-europe.org and one for our internal timetables and priorities http://ael.physic.ut.ee/elsee. We have also implemented an on-line discussion forum where all the teachers and co-ordinators can share ideas and comment on the draft materials as they are written.

Although the project communication language is English, all countries are producing initial materials in their own language. These will be translated before evaluation, and then when we are all happy with the materials, they will be translated back into all partner languages. With a bit of luck we should be able to extend this to all European languages, so making the project results available to everyone to share.

It will be a challenging project - not least because the EU funding was less than we had applied for, and the first 'advance' payment has still yet to appear - but we hope it will be very worthwhile. By the final conference we should have found where the best sources of data are for the different teaching themes that we have selected. There will also be a CD-Rom version of the materials, including the relevant 'mini-database' of GLOBE schools' information, so that e-learning can take place in a classroom situation without Internet links. Where there is an on-line connection, the CD will take users seamlessly to the international GLOBE database, allowing the more able students to look for more data themselves.

Overall we hope that **e-LSEE** (or Elsie, as we now call her) will provide a new way for GLOBE teachers to use data in e-learning activities in the classroom. Just as importantly, it will provide a resource for all teachers to find out about the GLOBE Programme and its many benefits - hopefully encouraging more to join GLOBE and collect even more data.

Integrating GLOBE into the Curriculum in Thailand

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Following the implementation of the GLOBE Program in schools in Thailand since 2000, the Institute for the Promotion of Teaching Science and Technology (IPST) has tried several strategies to encourage the use of GLOBE activities in schools to support the improvement of science education of the country. The key strategies involve not only the translation and localization of the GLOBE materials and equipment but also the development of guidelines for the integration of GLOBE activities into current science curriculum standards as essential academic learning requirements at all school levels.

The current national science curriculum standards developed by IPST focuses on the continuous development of the student learning process to attain both local and universal knowledge and scientific inquiry process skills. The curriculum framework comprises 8 learning standard strands for all school levels: 1) Living Things and Life Process; 2) Life and Environment; 3) Substances and Properties; 4) Forces and Motion; 5) Energy; 6) Changing Processes of the Earth; 7) Astronomy and Space Science; and 8) Nature of Science and Technology. We have examined all of these strands and found that most of GLOBE activities and protocols can be well integrated into the curriculum. In order to popularize GLOBE activities among science teachers whether or not they are in GLOBE schools, we need to create their demands. Our Globe team who are also academic staff of Chemistry, Biology, Physics, General Science, and Primary Science Divisions and involving in the development of exemplar learning materials (e.g. textbooks, teachers' guides etc.), for those disciplines, have introduced GLOBE protocols and resources to relevant concepts as suggested activities and referenced sources of further explorations for both teachers and students. In addition, Guidelines for Integrating Globe Activities into Science Curriculum Standards are being developed for teachers. They will be disseminated in both printed and online materials. Here are examples of what we have been doing to link GLOBE learning activities (Atmosphere) to the learning standards (strands 6 and 8).

Strand 6: Changing Processes of the Earth

Understand various processes occur on the earth surface and interior earth; the relationship of processes which affect the changes of climate, landscape and the shape of the earth; inquiry based learning processes and scientific mind forming; and ability to communicate and apply knowledge.

Strand 8: The Nature of Science and Technology

Using scientific methods and scientific mind as a tool for inquiring knowledge and solving problems; appreciate knowledge and solving problems; appreciate knowledge that most natural phenomena contain definite patterns and they can be explained and tested within the existing information data and tools; able to understand that science, technology, society and environment are interrelated

grade 1-3	grade 4-6	Strand 6 GLOBE Learning Activities: Atmosphere
possess knowledge and comprehension that air temperature is changeable and air temperature of different areas are different	possess knowledge and comprehension that changing of temperature, pressure and moisture, of the air effect the characteristics of weather and climate	**Learning Activities 9-12 Studying the instrument Shelter** **Key concepts** • Heat transfer through radiation, conduction, convection **Facts** • Factors such as wind, direct sunlight and moisture can affect a thermometer and so we must protect these instruments by placing them in a shelter that is built to a specific set of characteristics. (color, slits materials, size, shape) • Where the shelter is placed is critical importance • How the thermometer is placed inside the shelter is critical importance (touch or not touch the cardboard) **Learning Activities 13-21 Building a thermometer** **Key Concepts** • Substances expand and contract as the temperature change • Liquid in glass thermometers work on the basis of thermal expansion and contraction • Conduction and convection are two forms of heat transfer **Facts** • Both GLOBE thermometer + Soda bottle thermometer are based on the principle that most substances expand and contract as their temperature change • The liquid used in soda thermometer is water. The coefficient of expansion of water is quite small so the volume of the water increases by only a very small percentage. (Nonetheless because of the increase in volume is channeled into the small diameter straw, the expansion can be seen) • The warm water in the outer container transfers its heat by conduction through the plastic wall of the bottle to the water in the inner bottle • Heat transfer by conduction can occur in solids, liquids and gases. It is most efficient in solids and liquids. In the atmosphere, air in contact with the ground is heated by conduction. As these molecules gain energy, they become less dense and start to rise. • Convection is the large scale movement of a liquid or a gas which acts to redistribute heat through an entire volume (In case of boiling water, the water in contact with the bottom of the pot (where the heat source is) become heated and less dense than the water on top of it. This hot water rises, cooled water sinks and is then heated by contact with the bottom of the pot. **Learning Activities 22-24 Land Water and Air** **Key Concepts** • Different substances such as soil, water and air transfer energy and heat at different rates **Facts** • One of the important reasons why we have different kinds of weather throughout the world is because land and water heat and cool at different rates • Afternoon thunderstorm are often initiated by the fact that during the day the land heats up faster than the water does, In parts of the world that experience monsoons (Wind-systems that reverse direction seasonally), the rainy part of the monsoon season is characterized by alternating period of active (rainy) and non active (not rainy) weather depending on the land - dry or wet • The soil surface was much warmer at one cm depth than that of the water at one cm depth. On the other hand, the water was warmer at 8 cm depth than was the soil, After sunset the heat absorbed by soil quickly escapes to the atmosphere, and the land cools rapidly than water. Although water heats up more slowly than land once it is heated it takes longer to cool

grade 1-3	grade 4-6	grade 7-9	grade 10-12	Strand 8 GLOBE Learning Activities
1. Identify problems from guided questions or from their own curiosity 2. Identify diverse independent variables and hypotheses 3. Simply and accurately use the instruments in observing, measuring and collecting data to test the hypotheses 4. Organize and compare data with the hypotheses 5. Generate new questions from past observations and investigations	1. Identify problems from guided questions or from their own curiosity 2. Identify diverse independent variables and hypotheses 3. Appropriately and accurately use the instruments in observing, measuring and collecting data to test the hypothesis 4. Analyze and evaluate data qualitatively and quantitatively 5. Generate new questions from past observations and investigations that lead to new observations and investigations	1. Identify problems systematically by asking questions from their own observations 2. Identify testable independent variables and hypotheses 3. Appropriately and accurately select and use the instruments in qualitative and quantitative observing, measuring and collecting data to test the hypotheses 4. Appropriately organize and present different forms of qualitative and quantitative data 5. Analyze and evaluate the confirmation and deviation of the results (observation evidences and conclusions) and the hypotheses 6. Create scientific model to explain or present the results	1. Identify problems based on observations, background scientific concepts and theories 2. Identify testable independent variables and hypotheses based on background scientific concepts and theories 3. Identify control variables and the ways to confirm the reliability of the results 4. Appropriately and accurately select and use the instruments in quantitative observing, measuring and collecting data to test the hypotheses for broad and deep dimensions. 5. Appropriately, clearly, and accurately organize and present different forms of qualitative and quantitative data 6. Analyse and evaluate the confirmation and deviation of the results (evidence and conclusions) and the hypothesis 7. create scientific and mathematical model or identify trends or relationship between variables of the results to understand scientific concepts or laws 8. Identify and rationalize acceptable and unacceptable deviation of the results 9. Suggest different ways to improve and make use of the investigations	Learning Activities 9-12 Studying the instrument • Identify the characteristics and shelter placement. The GLOBE shelter that influence the temperature inside it (Predict the effect) - What are the major characteristics of the GLOBE shelter that could influence the temperature inside it? - color? Why? - slits? Why? - materials? Why? • What are the placement of the shelter and the thermometer inside that could influence the temperature inside it? - Why should the shelter be located away from the building and trees? - Why should it be placed over a natural surface such as grasses? - Why should it be placed 1.5 meters above the ground? - Why should the shelter be oriented with the door facing mouth in the northern hemisphere and south in the southern hemisphere - Why is the thermometer not supposed to touch the shelter? - Test the predictions • Construct two shelters **Vary** - color - black/white - slits - with slits/without slits - materials - meat box/cardboard box - placement - amounted/mounted at 1.5 meters high **Control** - actual shape and size - open area - natural surface - facing north in N hemisphere/ south in S hemisphere • calibrate thermometer before placing in the shelter • record the starting temperature • read temperature at 5 minutes-interval until the temperature have stabilized and do not change after the 2 successive readings • report and discuss the results [Adaptation - Younger students Variables - color/slits/placement on surface - Older students Variables (combination of variables) - making more than 2 shelters - test - whether color is more important than slits - what would be the effect of the white shelter became covered with a heavy layer of dust

Impact of GLOBE on Your Community

Education and Implementation Panel Report: Impact of GLOBE on Your Community

Collaborations in the Community: Cultivating the Common Ground

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GLOBE as common ground

GLOBE is the common thread that runs among the various science education programs that I am involved in. GLOBE is the basis of the various K-12 education outreach programs I coordinate such as the Alaska GLOBE Partnership, the Alaska Global Change Education Program, the Alaska Environmental Education Outreach Program, the Alaska Earth Systems Science Education Alliance: Improving Understanding of Climate Variability and Its Relevance to Rural Alaska, the Schoolyard Long Term Ecological Research Project and the Alaska Rural Research Partnership. GLOBE goals of improving student achievement in science, increasing student awareness of the global environment from a scientific viewpoint and, improving understanding of the earth as a system, are shared to some degree by other environmental education programs. I firmly believe in the conservation of energy and resources and see no sense in reinventing the wheel; thus I strongly advocate the use of GLOBE methodology in involving students in performing real science and collaborative research with scientists. GLOBE protocols and learning activities including the use of computer and network technology, developed by scientist-educator teams, tested by thousands of students and in use for more than five years, are increasingly being used by other environmental education programs. Schools are also using GLOBE as a means of teaching and learning science and to meet local and state science standards.

Common ground between Native knowledge and western science

In our efforts to teach Alaska students in a meaningful way, my co-investigators Sidney Stephens and Leslie Gordon, and I obtained funding from the National Science Foundation for global change education using Native observations and traditional knowledge with western science i.e. GLOBE, in engaging students in original climate change research. The common ground in organizing principles, habits of mind, skills and procedures and knowledge between Native knowledge and western science is illustrated by Stephens (2000) in Figure 1. This is both the foundation and the challenge to what we are trying to accomplish. The project is in response to identified needs for locally relevant, inquiry-oriented science education appropriate for the diverse multi-graded and multicultural teaching situations in Alaska. Alaskans as well as people from other regions need to be well educated about high priority global change issues such as climate change so they can make well informed decisions, prepare for consequences of global alterations and respond accordingly.

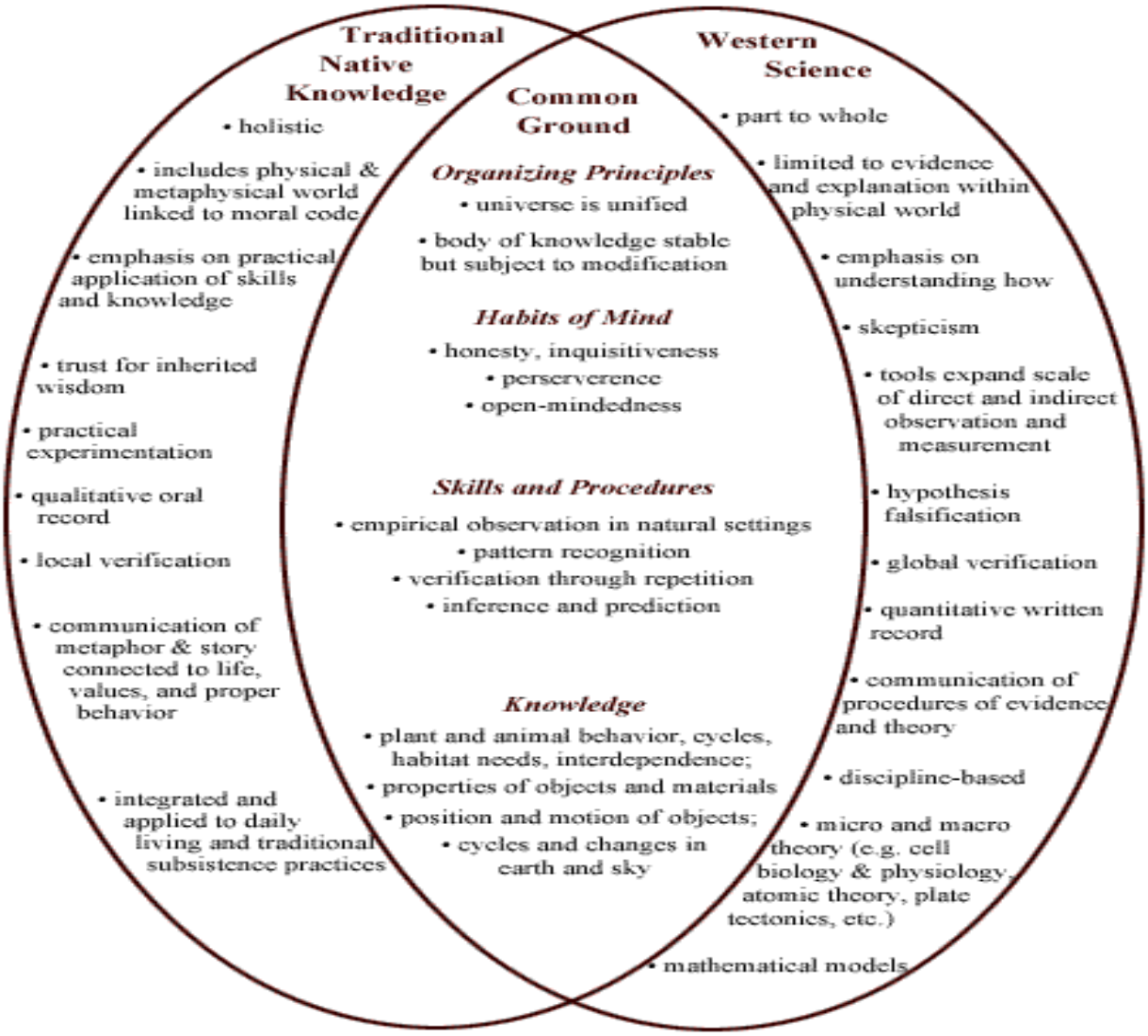

Figure 1 Similarities and differences between traditional Native knowledge and western science (Stephens, Sidney. 2000. Handbook for Culturally Responsive Science Curriculum Alaska Science Consortium and Alaska Rural Systemic Initiative, p.11)

Strategies for using both knowledge systems

To engage K-12 students in conducting local environmental change research and scaffold their studies with Native knowledge, their teachers are brought in for a two-week summer institute "Observing Locally, Connecting Globally" that integrates GLOBE protocols and learning activities, Native knowledge and observations and best science education practices. The teaching and learning processes during the institute occurred both in and out of the classroom. A field trip with Alaska Native elder and other Athabascan experts on the Tanana river, to the Gaale'ya Spirit Camp and the Fox Farm, laid the foundation for learning, the whole-system approach essential to understanding earth systems, and the inquiry process on climate change (Stephens, 2000b).

In the classroom the ideas of long term observations and systems-thinking are put into practice as participants started on the GLOBE scientific measurements and learning activities combined with input from Native elders and other community experts. For each of the GLOBE areas of investigation covered: Hydrology, Atmosphere/Climate, Soils, Land Cover/Biology, and Earth Systems, the format of Native knowledge/observations followed by GLOBE protocols was used. This model was used in the GLOBE Training for Trainers for Tribal Colleges held in Flagstaff, Arizona last year.

Other climate change research relevant to Alaska such as studies on sea and lake ice, and studies on boreal forest response to climate change were also covered in another field trip with University of Alaska scientists or follow-up session. During the institute, best classroom practices e.g. establishing a constructivist learning environment, teaching and assessing to standards, inquiry learning in science, learning cycle model, and teaching and assessing for diversity, were discussed and modeled (Gordon, 2001; Sparrow, 2001a). Participants also learned how to follow scientific protocols, analyze and interpret data, and to use the computer and internet for data entry, accessing global data sets and data visualization.

After teacher participants formulated their own research questions based on their interactions with the Native experts and scientists, they worked in small groups to conduct an investigation on their land cover/biology plots or on an environmental change issue, and, to present their findings. In another presentation the participating teachers demonstrated a GLOBE protocol incorporating Native knowledge and a best classroom practice. Back in their schools under the guidance of these teachers, K-12 students are involved in global change research and have started taking environmental measurements at or near their schools. Teachers and students are supported through email discussions, phone calls, classroom visits from project personnel, community experts and scientists, and alignment of project activities with state science standards and the Alaska cultural standards and a web site (http://www.uaf.edu/olcg/). The process of coupling Native knowledge and experience with science instruction and research investigations, aimed at enhancing global environmental awareness, the science skills and knowledge of students as well as their cultural well-being has begun.

Impact on Community members

GLOBE benefits for students, teachers, scientists and others were highlighted by Sparrow (2001b). Other positive effects include a greater involvement of family and community members in science education and research. Alaskan villagers are concerned about climate change and the impacts on their communities and subsistence lifestyle and are therefore interested in the local environmental change studies being conducted especially by their young people. Native elders are also interested in passing on their knowledge of the natural environment, knowledge that arose from their continuous observations of nature, trial and error, dogged persistence and successful living off the land in a particular area, as well as though stories and legends (Glenn,1999). Personally, I have grown immensely in my appreciation of multiple perspectives on science knowledge and ways of knowing. According to Inupiat elder Jonas Ramoth who has helped with our "Observing Locally, Connecting Globally" institutes and the GLOBE Training for Trainers: Weaving Common Threads in Arizona, his involvement has resulted in his doing more education outreach in the schools at Kotzebue and encouraging other elders who are not sure that their knowledge will be valued, to be similarly involved. At our last institute when teachers were practicing data entry, elder Ernest Sagoonik from Shaktoolik got interested and excited about using the computer to access the worldwide web. After a teacher participant and a student assistant showed him how to do it, he said "If I can learn how to use computers, the other elders can too". He plans to buy a computer that he, his family and other elders in the village can use. The blending of traditional knowledge with western science is a collaborative, iterative, difficult, yet enriching endeavor that is worth cultivating. We are continuing work on the strategies for its successful implementation in science education and climate change research.

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Education and Implementation Panel Report: Impact of GLOBE on Your Community

Impact of GLOBE in the Great Central Valley of California

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Abstract

In all of our teacher training workshops we stress the importance of making GLOBE the integral component for developing Learning Communities on local, regional and global scales. It is the purpose of this panel discussion to share some of the outcomes and benefits of these efforts.

On the larger scale GLOBE benefits communities through collaborative student projects that serve to promote environmental awareness and studies of issues that are shared throughout a region. The Program offers opportunities for traditionally underserved rural and urban student populations to participate in scientific research that is real and relevant along with access to technology that in most cases was previously unavailable.

Through cultivation of affiliations with local and regional government agencies, educational and environmental organizations, and business and industry there has been a marked increase in communication, sharing of resources, awareness of common goals and a spirit of cooperation among all involved.

The ultimate contribution of GLOBE to communities is seen in the increased knowledge, understanding and appreciation of science and the environment in students and the methods that they subsequently develop to communicate what they have learned to their communities.

Regional Level: Interest, Cooperation and Support

Over the years GLOBE has become an integral part in both formal and non-formal K-12 science and environmental education in the six counties (Fresno, Kings, Madera, Mariposa, Merced and Tulare) that comprise the heart of the Great Central Valley in California. Science education leaders, government agencies, environmental groups, and business and industry have developed associations that bring representatives together on a regular basis to coordinate calendars and share information and resources between groups that had previously operated in isolation. The Central California Science Education Leadership Association (CCSELA), an affiliate of the NSELA, meets monthly throughout the school year bringing together school district Science Coordinators, university pre-service teacher educators, directors of environmental organizations, outdoor schools, and education outreach representatives from agencies such as the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service and the California Department of Fish and Game. The outcome from this collaborative effort is that each entity is supported by each of the others and promoted at all of the appropriate individual events throughout the year.

Members can depend on others in the group to distribute their materials and promote awareness of their programs whenever scheduling conflicts and demands prevent them from attending events. The resultant peer support for GLOBE is a very efficient and effective method for generating interest in the Program. Some examples of regional impact include:

- Collaboration with the WildLink Project (see Fresno GLOBE Annual Report) sparked the interest of the rangers and forest service personnel in Yosemite National Park after they observed students collecting data and asked about the purpose. The officials came away with an appreciation and recognition of the potential power and benefits of student-based research on government lands. "We should have been doing this 50 years ago," remarked Jim Tucker, Supervising Ranger in Yosemite.

- Participation in the development of the statewide California Regional Environmental Education Community (CREEC) Network led to a working relationship with the California Air Resource Board (CARB) to develop a project between GLOBE schools to conduct ozone studies. CARB is providing financial support for schools in the Valley to join the efforts currently underway in the south part of the state begun by GLOBE's Los Angeles Partner Coordinator Henry Ortiz.

- Fresno GLOBE Trainer Scott Kruse and Training Coordinator Dave Williams participated in the Watershed GIS (Geographic Information Systems) course held in Grand Forks, ND, this June. While at the week-long workshop the two gave a presentation on GLOBE and demonstrated how student data could be incorporated into GIS to enhance projects and long-term studies. From this brief sharing of information a strong interest in becoming involved with GLOBE on the part of the school district and a desire on the part of the instructor Dr. Joseph Kerski, Education Outreach Coordinator for the USGS, has evolved to collaborate on developing workshops on remote sensing and GIS using GLOBE data and Landsat TM imagery. The connection with the USGS will expedite and enhance the planning for the Central California Transect (CCAT) Project, also mentioned in the Fresno GLOBE Annual Report.

Local Level: Students in Action

While regional impact on communities is an important component of our GLOBE goals, a more compelling element is found in asking what are the effects locally? Specifically, are we empowering our students? The following are three examples of GLOBE students in action:

- Kingsburg High School (KHS) students began collecting data in 1995. They established hydrology, soil and land cover study sites in an old abandoned Tulare County Park outside of town along the Kings River. The park had been closed to the public due to vandalism, drug use and other inappropriate behavior. A proposal was made to the county planning authority to rezone the land for development. GLOBE students at KHS generated interest in the community, got their parents involved and were able to save the park. The Kings River Nature Preserve is now protected and available for ongoing student investigations and teacher training workshops.

- The Center for Advanced Research and Technology (CART) is a joint effort between the Fresno and Clovis Unified School Districts with support from local business and industry. Juniors and seniors from local high schools spend a half-day at their home school and the other half at CART where they are enrolled in one of the 12 strands that are focused on applications of technology in various scientific disciplines. The student work is project based and may cover periods of 2-3 months duration. There are three GLOBE trained teachers in the Environmental Science School. During the 2001/2002 school year their students spent three months on an intensive study on the City's water supply, its quality, quantity and reliability. The students presented their findings to the public and explained their work during a three-day open house. The City Council members, local educators and all who attended were thoroughly impressed with their accomplishments.

- In early May this year the City of Fresno experienced sudden elevated nitrate levels in three water wells in the north part of the city. With hot weather, and resultant water use approaching peak seasonal levels, there was serious concern about being able to maintain pressure in the system to ensure a safe water supply due to the closure of the wells through the summer months. GLOBE students in Mr. Mike Mirigian's three AP (Advanced Placement) Environmental Science classes at Clovis West High School rallied together after completing their final exams and spent two days distributing flyers on how the community could help get through the summer through their landscape watering practices and maintenance of automatic sprinkler systems. The GLOBE students delivered two flyers to approximately 7,000 students in seven elementary schools in the affected area. They also formed three member teams that went to 21 classrooms at two school sites and provided presentations for the students. The students not in this year's graduating class have decided that they would like to do more of this type of activity and are planning to develop more in depth and varied environmental awareness programs that they could deliver to classrooms throughout the district next year. Several have expressed a desire to do animations and create videos in the school's multimedia center. Surveys returned from the teachers' classes that received the presentations show 100 percent support all with comments that are very enthusiastic.

Individual Level: A Case Study

The WildLink Project (mentioned above and in the Fresno GLOBE Annual Report) has probably had the most systemic impact on our GLOBE communities, from the regional to local, and from administrators to teachers, to students and their parents.

Myra, a young Hispanic high school student, has not been in this country for very long. She has struggled in her classes with her thought processes working in Spanish, having to take time to mentally translate what she is trying to learn into English.

Myra's home environment is reflective of much of our country's immigrant populations in which the parents not having had the opportunity and benefits of an education do not see or are unable to communicate the values of it to their children. Myra's father's expectations were for her to get married and have children after completing high school, if not before. At

school Myra was told that she should not sign up for any AP courses since the language barrier would make them too difficult for her. The obvious implication being that she wouldn't be going on to higher education. Myra signed up for AP Biology (the hardest course at the school) and AP History.

Myra participated in WildLink, a project that provides traditionally underrepresented students a chance to experience the wilderness, participate in scientific research, and gain knowledge of different cultural experiences and artistic impressions. Myra's teacher related that while camped in the backcountry he awoke one morning at 3:00 AM to find Myra sitting on a rock doing her homework by the light from the full moon.

Upon returning home from her experience in the mountains Myra announced to her father that she would be going to college. She has made this clear in no uncertain terms to her teachers as well. She is determined and impassioned, no one and no thing will stand in her way.

Myra has become quite outspoken in her beliefs at school as well. Working at a national Mexican fast food chain, where she was promoted to manager, she helps to support herself. She shares her feelings with her class telling them "You don't want to work there, you want to go to university."

Myra was one of several students that were invited to attend the evaluation of the WildLink Project held in June 2001. The Project coordinators, teachers and independent evaluators listened as each student spoke and articulately described in detail what they had gained in knowledge and skills, learned about themselves and others, and finally how the experience had completely changed their attitudes, outlooks and lives. When the students had finished there wasn't a dry eye in the house.

Conclusion

GLOBE has the power and potential to impact communities at several scales on a number of levels. There can be a tendency in today's world of increasing workloads, multi-tasking and deadlines in our roles of scientists, administrators and educators to focus on the larger pictures, Quest for the GLOBE, data reporting, meeting standards, raising test scores, funding programs and projects, all vital components. The ultimate contribution of GLOBE will be seen in the critical thinking and problem solving skills that each student brings to their community as they grow and mature into responsible citizens and leaders. Almost anyone who has taught for any length of time, especially at the secondary level, will tell you that there is a small percentage of students in any class that will not succeed or perform no matter what the teacher does and another small percentage that will succeed in spite of what the teacher does. We need to keep in mind that the Myras and other "average achieving" students of this world are the majority. Isn't this where we would like GLOBE to be recognized for having the most impact?

Education and Implementation Panel Report: Impact of GLOBE on Your Community

Impact of GLOBE Program in the Community: Nepal

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Nepal is a small country on the southern lap of the Himalayas having about 885 km in east-west direction and a mean north-south width of 193 km and covering an area of 147,181 sq. km. The country is located between 26°20' and 30° 10' north latitude and 80° 15' and 88° east longitude and presents a unique transition zone between arid, cold and sparsely populated Tibetan Plateau of China in the north and humid, hot and densely populated India in the south. In north-south direction there is an altitudinal variation ranging from less than 100 meters in the south to 8848 meters in the north. The altitudinal and climatic variation has led to a natural division of the country in three broad ecological regions teria, hill and mountain.

On March 3, 2000, Nepalese Secretary of Education Mr. Jaya Ram Giri and U.S. Ambassador Mr. Ralph Frank signed an agreement to initiate the GLOBE program in Nepal at a special ceremony held at the Ministry of Education in Kathmandu. To implement GLOBE program in Nepal, a Program Implementation Committee of nine members representing different Government Ministries and non-government organizations has been formed. Joint Secretary of Ministry of Education and Sports and Environmental Camps for Conservation Awareness (ECCA) has been given the responsibility of Chairman and Member Secretary/Country Coordinator respectively.

Environmental Camps for Conservation Awareness (ECCA), established in 1987 as a non-governmental, non-profit making and non-political organization - is a member of The World Conservation Union (IUCN). It is registered with His Majesty's Government, Nepal and affiliated with Social Welfare Council, Nepal. Its primary objective is to raise awareness on conservation and sound resource management in children - and through them, the community.

In Nepal, there are 25522 primary schools, 7276 lower secondary schools and 4082 secondary schools including private schools. Considering just the urban areas, there are 2702 primary schools, 1421 lower secondary schools and 997 secondary schools. The quality of education in government schools is very poor than in private schools. They don't have proper training and necessary teaching materials to improve their teaching method. They teach in one-way lecture method, which is not so effective.

According to the past training experience, the teachers have found the GLOBE training to be very unique and most effective training that they ever had. This training helps them to learn more and also helps to change the teaching method. Now they have realized that the hands-on

activities makes it easy to teach and is more informatics than the lecture method. GLOBE program also helps to know the first hand information of the surrounding environment and makes the participants realize about it. This helps them to change in behavior, which is most important to achieve the goals.

GLOBE program helps students to improve their study. They can collect the first hand information and know the exact environment of surrounding. The GLOBE data also helps them to design the awareness program on local issues and disseminate to the community through various programs. The collected data will be used in the future for the monitoring and study of the changes.

Nowadays, it has been realized that the GLOBE program is the most important hands-on activities for the students. Keeping this in mind, King Mahendra Trust for Nature Conservation (KMTNC)/ Annapurna Conservation Area project (ACAP) requested to conduct GLOBE Training Workshop for the school teachers of their project area and has planned to integrate GLOBE activities in the school curriculum.

Financial support is very important for implementing the GLOBE program. In the present, GLOBE program in Nepal is running without any support and grant. All the work is totally voluntary from all sectors. I personally appreciate and thank all for helping me to bring the GLOBE program in Nepal to this state. The GLOBE program will be more effective and useful if it could be expanded throughout the country through financial support in future, which will also help scientists to get diverse data from this country, which has rich bio-diversity.

In Nepal, more than 70% people are dependent on agriculture and GLOBE data may play a vital role to know the condition of their agriculture land. It is also believed that the GLOBE data will help to increase the capability of research among the school children and provide the necessary insights and ideas to forge ahead. Science-based educational program not only enhances the children's knowledge of their environment, but also helps them to perform better academically in the disciplines of science and mathematics - which are vital for their future, and Nepal's.

Education and Implementation Panel Abstract: Impact of GLOBE on Your Community

UNHCR/OFADEC GLOBE Refugee Program in Senegal

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In 1998 UNHCR decided to implement GLOBE program in 4 Refugee schools in Senegal. What are the reasons behind this decision? How can refugees who fled their countries because of violence or war have an interest in GLOBE program in schools?

UNHCR have to manage large numbers of refugees around the world, in 1997 Guinea Conakry hosted more than 800,000 refugees from Liberia and Sierra Leone. Those refugees were settled along the border and live in rural areas. Their presence was a threat to the environment of Guinea Conakry. The 800,000 refugees have to clear land for housing, farm, use trees to built houses, use wood as fuel and cut and sell wood for cash. The negative impact of large number of refugees in many parts of the world has been demonstrated by studies or field assessment.

This is one reason why UNHCR has developed an environment Unit whose job is to work and try to restore the negative impacts left by refugees when they return home. This unit have conducted restoration program in many countries. Confronted with the reluctance of host countries to accept refugees because of the risks they face among those risks environment disasters, the Environment unit has to put as a priority education on environment for refugees in camps.

How this program was received by refugee children in Senegal? It was not clear enough for refugee parents and when the program started, parents and students went together for the first atmosphere activity. Refugee teachers were trained as GLOBE teachers and were involved in the program. These choices bring confidence to parents who accept the participation of their children. Refugee children use this program to learn more on environment through testing and outside activities. Refugee children enjoy the outside activities and were happy to be outside the daily difficult life of refugees in camp in a foreign country.

The program has developed interest in sciences and mathematics and many of the students following this program have decided to go for science at the university. We have now very good refugee students in math and physics in Dakar University. This year one of the schools received an award from NOAA for their contribution to atmosphere study.

Education and Implementation Panel Abstract: Impact of GLOBE on Your Community

The GLOBE Program's Hidden Effects on Teachers

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One of the goals of the GLOBE Program is to improve student achievement in mathematics and science. In order to achieve this goal, GLOBE's primary instrument of change is the classroom teacher. Most of GLOBE's impact on students is mediated through the teacher. Through the GLOBE Teacher's Guide and the Teacher Workshops, the GLOBE program provides materials, skills, and knowledge to help improve teachers' abilities to teach mathematics and science.

GLOBE tends to measure its success by the metric of data submission to the GLOBE server, and, indeed, this is one measure of success. However, data submission underestimates the degree of change that GLOBE is causing in the classroom. As a result of their participation in GLOBE, teachers are changing the way they think about science, science education, and inquiry. They are changing the way they teach, their attitude toward and use of data, and their attention to careful observation of the natural world. They are changing their understanding of the scientific endeavor and their sense of participation in it. Examples drawn from three years of work with GLOBE teachers in Massachusetts show that GLOBE significantly changes not only how teachers think but what they do in the classroom even when they do not submit GLOBE student data.

These teachers in Massachusetts have continued to develop professionally after their initial GLOBE training through participation in a professional community sponsored and supported by TERC and the Spencer-East Brookfield GLOBE Partnership. The success of this community suggests that similar support efforts for all GLOBE-trained teachers would be a valuable contribution to the improvement of science teachers and teaching through all levels of K-12 education in the United States and perhaps the world.